APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

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- HYDRAULIC CONTROLS
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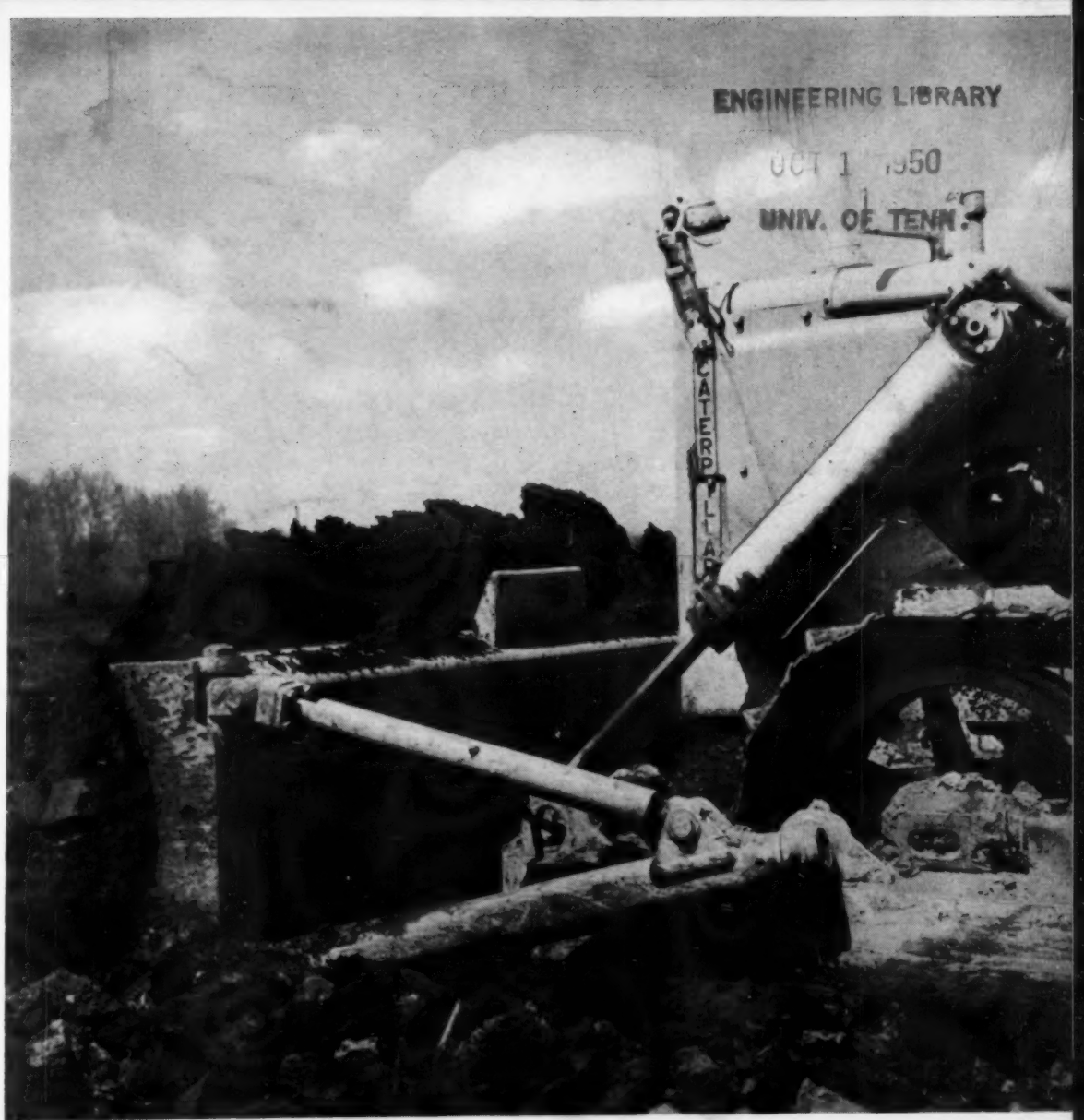

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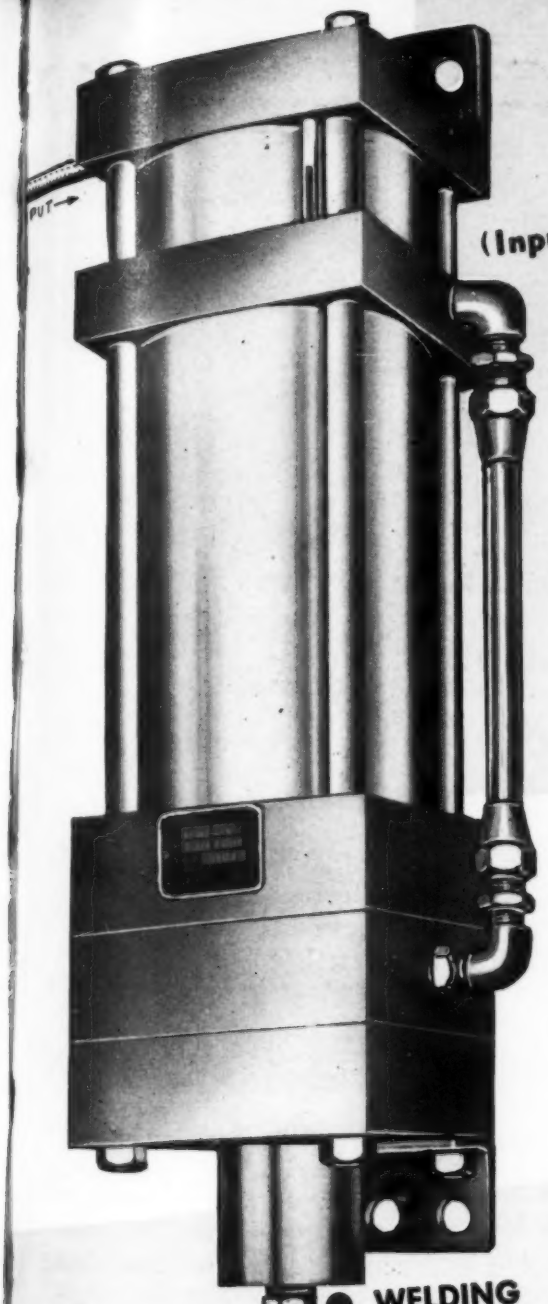

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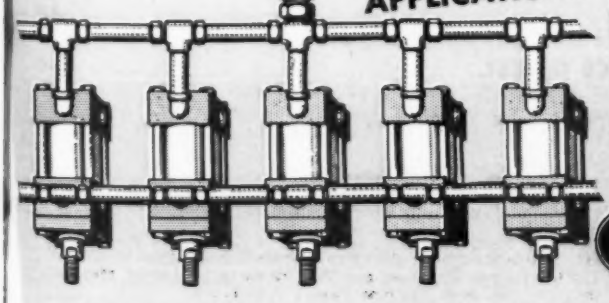

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AUGUST, 1950
Vol. 3 No. 7

APPLIED HYDRAULICS

The Magazine of Fluid Power Transmission

FRONT COVER: Hydraulic bulldozer on a "Caterpillar" Diesel D7 tractor leveling land for farm use on the Frank Foster property near Wyoming, Ill.
Courtesy Caterpillar Tractor Co.

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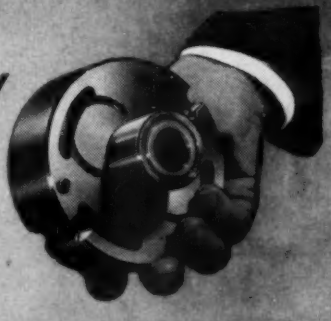
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

3984

VICKERS Cartridge Assembly



This cartridge contains all the pumping parts that move . . . none of them contact the housing. Inspection and removal of all working parts can be made without disconnecting piping or drive coupling.

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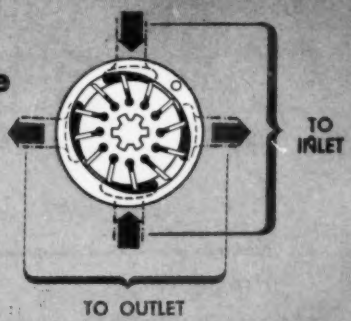
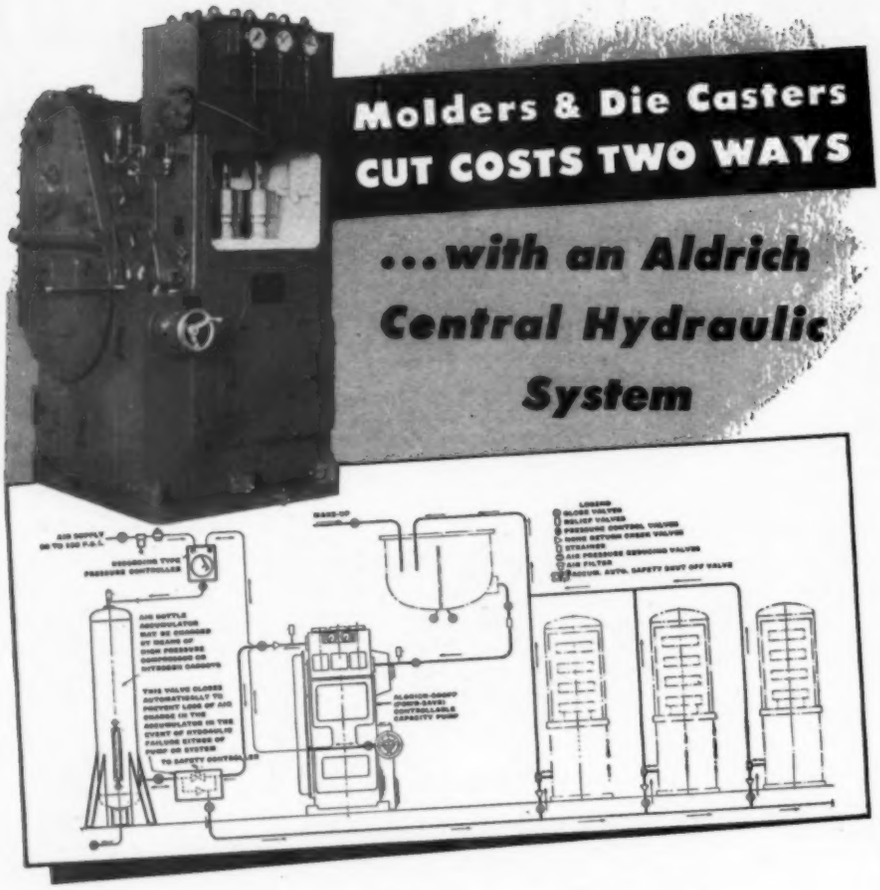


With this patented construction, bearing loads are cancelled out by equal and opposing radial hydraulic thrust loads as shown in diagram. The result is longer pump life with minimum maintenance.



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A-3. AUTOMATIC SWITCH CO. Engineering service is offered to assist in solving automatic control and remote control problems.

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A-7. HUFFORD MACHINE WORKS INC. Engineering recommendations and estimates for building hydraulic equipment can be had.

A-8. L & L MANUFACTURING CO. Technical data and catalog of piping needs is offered along with service on special fittings.

A-9. LEDEEN MFG. CO. Applications, selection and features of Ledeen cylinders are presented in a new Bulletin 500.

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A-14. MILLER MOTOR COMPANY. Cylinder Bulletins A-105 and H-104 illustrating the air and hydraulic line are offered along with Bulletin B-200 which details fluid pressure boosters.

(Continued on page 36)

LETTERS *to the Editor*

The article "Theory and Practice in Design of Hydraulic Seals" by R. O. Isenbarger is extremely interesting and I intend to incorporate it as part of my file. If reprints are available of parts 1, 2 and 3. If, so, I should like a complete group of these articles. Your attention to this matter will be appreciated.

W.S.G.

The Isenbarger articles are collectively the paper delivered by Mr. Isenbarger at the 1949 National Conference on Industrial Hydraulics. This paper has been reprinted and the author will be glad to send a copy to you.

Since circuits are so important to operating engineers and to maintenance personnel alike, we would like to suggest that you run typical circuits on a data sheet style regularly in APPLIED HYDRAULICS. In addition to our 'inside" use of circuits, our salesmen like to select circuits that you publish and include them in their sales portfolios.

D.S.

Your suggestion is a good one and timely. You will be interested to learn that we are working on such a series of circuits now and hope to be able to begin such a "data sheet style" presentation in either our September or October issues.

In an article in APPLIED HYDRAULICS of February 1948, written by R.H. Hensleigh, I became highly engrossed, and would greatly appreciate it if you would refer me to any other articles or references to hydrostatic transmissions. I am particularly interested in the application of hydrostatic transmissions to automobiles.

A. R. M., JR.
Lexington, Ky.

Reference to several recent and authoritative publications on hydrostatic transmissions have been sent to you.

We were very much interested in the article by T. J. McCuistion and R. E. Allen in your June issue. Can you give us the names of several firms who specialize in this type of product?

L.F.
London, Ontario

The names of several leading manufacturers have been sent to you.

We would appreciate a copy of "Reduction of Hydraulic Noise and Vibration" which appeared in a late issue of APPLIED HYDRAULICS.

C.V.G.

(Continued on page 50)

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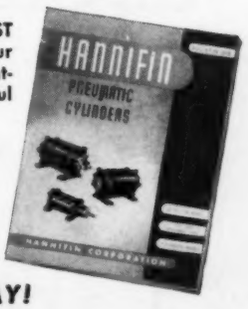

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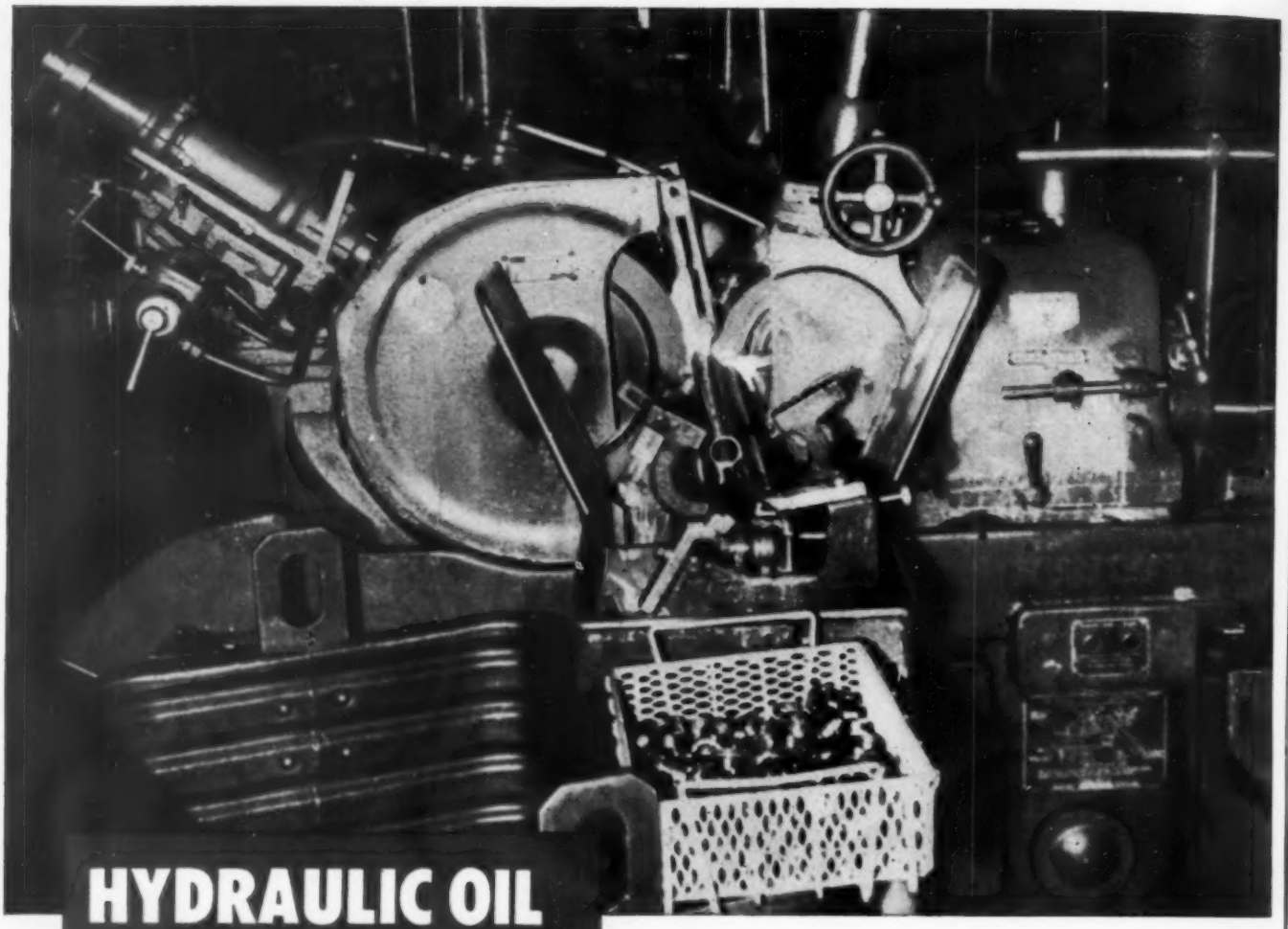

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HIGHER PRESSURE TREND IN MODERN PRESSES

By R. S. CONABEE
Chief Engineer
MacMillin Engineering Corporation
Chicago, Illinois

THE TENDENCY TOWARD HIGHER OPERATING HYDRAULIC pressures is evident in fields of application such as aircraft, agricultural implements and earth moving equipment. For aviation and other mobile hydraulic systems, high efficiency plus weight and space economies are obvious necessities. Additional advantages in cost, floor space and weight are important in the economy of industrial applications.

In the aviation field research has indicated that transmission efficiency increases as pressure is raised somewhat beyond 6000 psi,* that the lower mass of liquid in the higher pressure system would reduce the surge control and time lag problems, that cylinders, pumps and valves would be smaller and probably lighter and, of particular importance in modern airplanes, that higher pressure systems would operate at much improved efficiencies at extreme low temperatures. However, limitations in available pumps, fittings and seals have restricted designers to the present Air Force-Navy specification limit of 3000 psi.

In farm machinery, pressures in operating hydraulic circuits have advanced in a few years from 300 psi to 3000 psi in some cases, with the trend toward still higher ranges. In earth moving equipment the same tendency is evident. A representative manufacturer of automotive assembly equipment has gone to 4000 psi and predicts even higher pressures.

Higher pressures, i.e., pressure in the 6000 to 7000 psi range, are not new in heavy industrial presses, particularly extrusion presses. These pressures have been used for more than fifty years with water as the hydraulic medium.

Water hydraulic systems offer some advantages. However, the common practice of throttling the entire pump delivery for speed control creates an energy loss which, converted to heat, is dissipated into by-pass water or a large reservoir, plus problems of leakage, corrosion and

* *"The Problems of Hydraulic Systems in Large Airplanes," David Grant, APPLIED HYDRAULICS, July, 1949, p 17.*

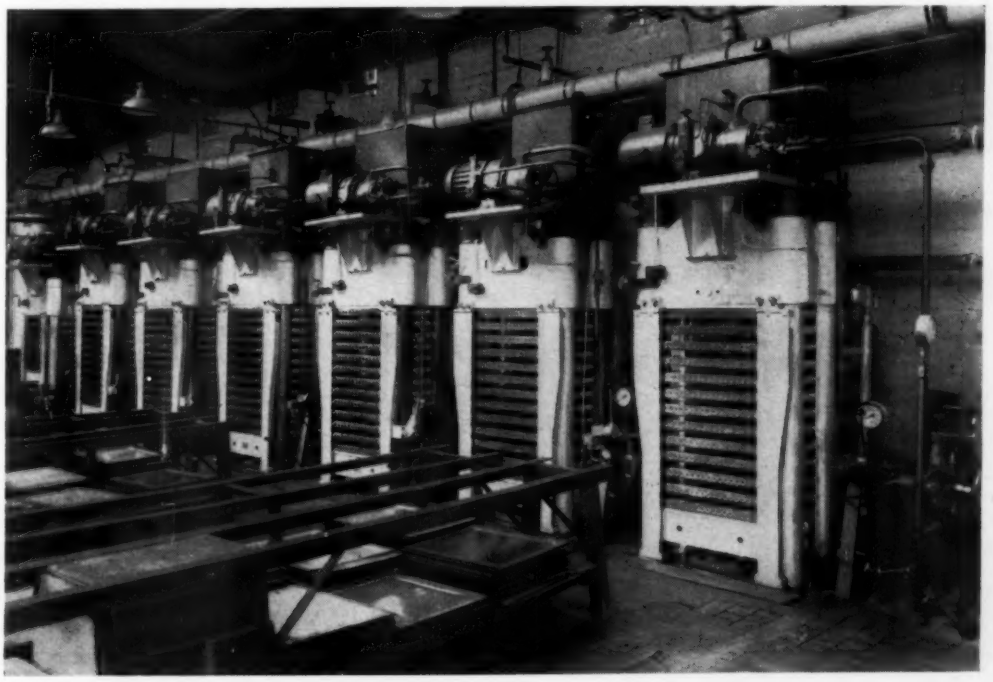


Fig. 1. Self-contained hydraulic systems individually mounted above multiple platen presses replaced a single system and accumulator. Note the old water screw valve in the right foreground.

short packing life presents a continuous handicap to the heavy press industry. An increasing number of water press users, concerned with maintenance costs and down-time incident to repacking and replacement have become interested in conversion to oil as a means of reducing their problems.

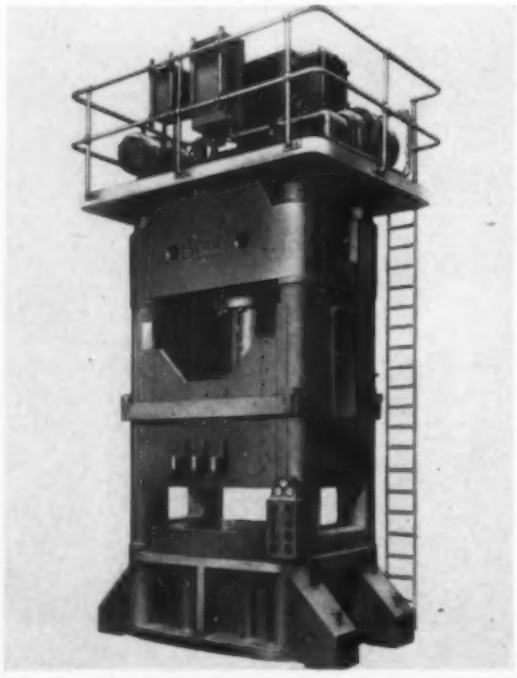
The direct conversion of existing high pressure water presses has not been easy, due to limitations in available pump and valve equipment. Since high quality gear pumps, radial pistol or rotary plate valve pumps have pressure limitations in the neighborhood of 2000 to 2500 psi, an additional outlay for intensifiers is often required. In recent years some high pressure pumps developing 5000 psi peak pressure and upwards have been marketed and successfully applied where the time of peak pressure requirement falls within the service factor recommended by the manufacturer. However, these pumps are not rated over 3500 psi for continuous duty which presents a problem on long stroke extrusion presses.

Redesign of presses for oil using continuous ratings of 3500 psi, 2500 psi or lower has not been the best solution, particularly in heavy extrusion presses where large pressing platen areas are not required. The increased ram and cylinder size results in a greater spread of strain rod centers and consequent enlargement of head and bed reaction members for the same tonnage conditions.

J. I. C. Standards

The J.I.C. conferences were organized to bring order out of a serious condition that was plaguing the machine tool industry. In the streamline fad of the past decade, hydraulic components on various machine tools were literally assembled in layers and crowded into odd corners in order to be covered with a smooth outer housing. When trouble developed, it often took hours to disassemble a machine and remove the outer layers to effect a relatively minor repair. It is no wonder that industry called a conference to do something about it!

Fig. 2. A 400-ton, automatic single cycle press with two axial plunger high speed pumps mounted on top of the press.



In a great majority of cases the hydraulics involved were a secondary system. That is, the hydraulic circuit was used for feeding, positioning, clamping, indexing, raising or lowering, or one or more of the multitude of operations hydraulically possible, but on a machine where the prime cutting tool is directly driven or geared from an electric motor. Most of the trouble has been developed in these circuits in which pressures were usually of a low order.

The J.I.C. discussions revolved around pressures used in these secondary circuits and in defining them, the J.I.C. Standards list as the "High" bracket, 1200 to 3000 psi. All pressures over 3000 psi are designated "Extra High". In other words the Standards contain very little data on high pressure operation.

Since this would make it difficult to define pressures at various higher levels it would seem better if the pressure brackets were designated by letters or numerals in corresponding order so that the industry would have something to build on. As it is, there is a ceiling implied by the present definition.

We are discussing presses using 6000 to 7000 psi pressures that have been used successfully for many years. This range may be only transitory. Pressures of 20,000 psi and 25,000 psi are long since out of the laboratory and are in constant use in manufacturing processes.

The industrial hydraulic press obviously employs a primary system with a pressure range of 2000 to 7000 psi. It may be considered that oil presses in the 4000 to 7000 psi range are in the development stage in this country. As dependable pump and control equipment in this pressure range are available, the overall economies of a high pressure system will dictate a trend to the higher level.

The writer has had opportunity to study many installations in this country and in England, including Scotland, and has come to the conclusion that from the time we adapted Joseph Bramah's cylinder to press cider out of apples, evolution at first paralleled developments in England, then branched off into almost a new species when we entered the recent era of high production tooling. High idolators of the gimmick, we have developed push button stations and full or semi-automatic electric circuits to control the functions of hydraulic operation. We have applied hydraulics to the machine tool so that now thousands of duplicate parts can be made from a single master template on a lathe, profiling machine or other, using sensitive follower equipment. We have swift automatic clamping and chucking equipment and directly driven hydraulic planers and broaching machines that have made production records.

The heavy oil hydraulic press frame has developed at a slower rate. It has been somewhat streamlined, equipped with automatic controls and its pressing speeds have been increased, but little change has taken place in basic cylinder construction. A pressure level of 2000 to 2500 psi was reached some twenty-five years ago and until recently, cylinder sizes and hydraulic systems have been predicated on that basis.

In England, less stress has been put on the push button and automatic circuit. Manufacturers there have brought out dependable high pressure pump and valve components and these have gained wide acceptance particularly in the

past decade. Press development has altered as a consequence, 6000 and 7000 psi presses being as commonplace as presses in the 2500 psi level in this country. Possibly this trend has been accelerated by greater necessity for economies in cylinder and frame members and in power requirements, but it was definitely aided by the advent of high pressure hydraulic components which give reliable service over long periods and require little attention.

As a result, the former English practice of operating batteries of presses from a single accumulator is largely being suplanted by self-contained systems applied to each press unit. Figure 1 shows such a conversion. Note the old water screw valve in the right foreground.

Many users of high pressure water systems have found it expedient to convert to oil. Aside from reduced maintenance on pumping equipment, these manufacturers report increased packing life and its obvious effect on production. One, in particular, offers an excellent comparison in packing life under varying conditions. Before conversion, packing life varied from two to three weeks to an occasional six months. With no change in packing conditions other than the change to oil, the life frequently exceeded twelve months and is never below seven.

A comparatively recent complete conversion was made by the same company to incorporate the most modern packings, and when last reported the initial installation had been in service for fifteen months without leakage being observed. This was on a 24 in diameter ram operating at 6000 psi.

Press Design Factors

An ever-increasing cost consciousness in this country is bringing attention to bear on higher pressures. Aside from longer packing life, the most obvious economies are in cylinder sizes, tubing diameters, valve sizes, etc., but the experienced press designer will see numerous others. Some of these do not apply to low tonnage presses of large bed areas where the frame sections are dictated by strain rod clearances, pressing areas and similar considerations. However, there is a wide field of presses, usually of heavy tonnage, including extrusion, coining, hobbing, forging and deep draw presses, where large areas are not important. In many such cases, strain rod centers are dictated by limitations imposed by the outside diameter of the main cylinder.

For example, let us assume a four rod, 1500-ton press with a ratio of two to one between front and side strain rod centers and, to simplify comparison, assume the strain rod cap nuts tangent to the main cylinder outer diameter.

Working pressures of 6000 psi and of 2500 psi are assumed for comparison. The lower pressure results in a large cylinder OD and computations show that a rectangle encompassing the strain rod nuts, roughly the minimum outside dimension, is 17 percent larger in area than a similar rectange enclosing the 6000 psi design.

The greater strain rod spread of the 2500 psi design also results in a 15 percent increase in the bed bending moment which, of course, requires more metal or a deeper bed for comparable stiffness.

For presses of this type the figures illustrate that overall frame member area and imposed bending moments have a greater effect on weight than cylinder diameter.

One basic argument used against the use of high pressures is the exponential increase in viscosity with increase in pressure. However, the viscosity gradient is less steep with the lighter oils which has a considerable effect on transmission efficiency using this medium.

A prominent pump manufacturer specifies an oil whose viscosity is 130 centistokes at 100 F and atmospheric pressure. This viscosity range is about midpoint of oils specified by all manufacturers of this type of pump. The viscosity of this oil increases to 210 centistokes at 2500 psi (pump maximum pressure) and to 400 centistokes at 6000 psi, holding the temperature constant—certainly a good argument against the use of higher pressures.

But again we must consider the limitations of equipment. This oil was selected to suit a pump using rotary sealing valves. English manufacturers have designed equipment to use lighter oil by eliminating the clearance seal in favor of the positive seating valve. The viscosity recommended is 10 centistokes at atmospheric pressure which increases to 19 centistokes at 6000 psi and 100 F.

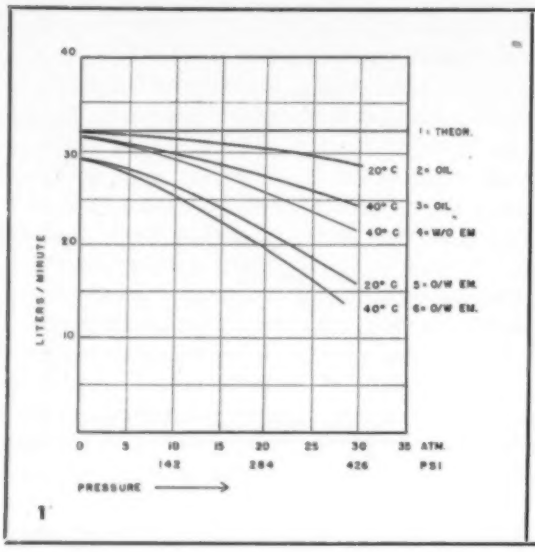
The latter viscosity at 6000 psi is far lower than the former oil at atmospheric pressure, but since these values cannot be compared numerically for practical purposes, perhaps an example will illustrate the effect on transmission efficiency.

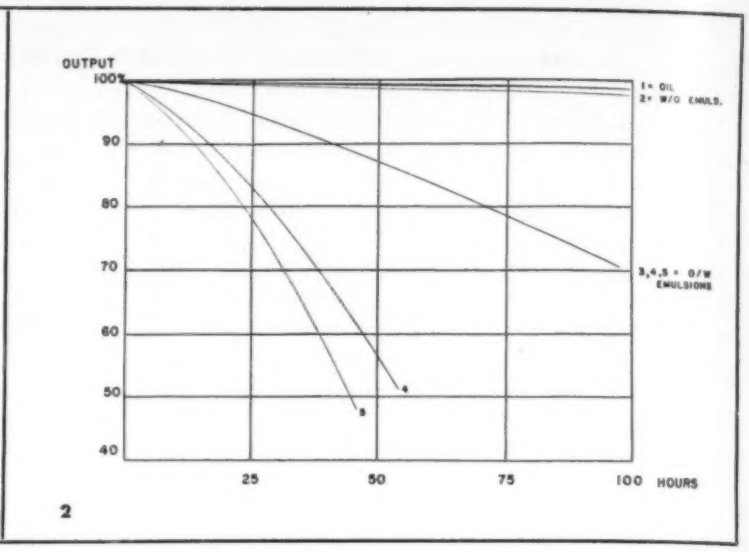
Let us select a length of one inch ID tube 50 feet long and make comparison on the basis of recommended flow practice. Assume a 10 fps velocity for the heavy oil, and 20 fps for the lighter which is higher than normally used. The heavy oil at 2500 psi will have a calculated friction loss of 63 psi or 2½ percent of the total. Friction loss of the light oil under the conditions indicated at 6000 psi, shows a friction loss of 50 psi, or less than one percent.

This has little significance unless the energy transmission rate is considered. Disregarding friction loss, the hydraulic horsepower rate is 35.7 for the heavy oil condi-

(Continued on page 42)

Fig. 3. This 2000-ton lead extrusion press was converted from water to a high pressure oil hydraulic system.





Emulsions as Hydraulic Fluids

By DR. KARL F. HAGER
Ordnance Research and Development Division
Suboffice (Rocket), Fort Bliss, Texas
and
MORRIS ROSENTHAL
Universal Engineering and Chemical Consultants, El Paso, Texas

CAN WATER AND OIL EMULSIONS be substituted for straight hydraulic oils?

Oil-in-water emulsions are those in which there are finely divided particles of oil suspended in water. Water-in-oil emulsions are those in which minute droplets of water are dispersed in oil.

Demulsibility, the power of a hydraulic oil to separate from water and prevent emulsification, is recognized as a necessary property to maintain lubricating and sealing value. Contrary to this accepted demulsibility requirement, are the results of experimentation with certain water-in-oil emulsions. These emulsions have proved to be usable and have the advantage of decreasing fire hazard. In abnormal times, valuable hydraulic oil could be saved by the substitution of emulsions.

A gear pump was selected as the best testing equipment for determining the suitability of hydraulic fluids. A test set-up was devised which permitted charting the output of the pump, the working pressure, the temperature of the hydraulic fluid and the duration of the tests.

Figure 1 illustrates the effect that increasing working pressure has on the output of the pump.

Figure 2 shows the effect of op-

Comments

By C. E. PRITCHARD*

Results of the physical evaluation tests of the various types of hydraulic fluids indicate that the oil-in-water emulsions are unsatisfactory due to an extreme wear of the pump member; whereas satisfactory service life was noted when the water-in-oil emulsion or straight oil was employed.

Several questions immediately arise:

1. Where is the line of demarkation between oil-in-water and water-in-oil emulsions?

2. Could additives which would impart anti-wear characteristics be incorporated in the emulsion?

3. What could be done to prevent a phase change in the water-in-oil emulsion which might result from evaporation during operation?

4. What benefits might be derived by going to a heavier viscosity mineral oil with sulphurized and chlorinated extreme pressure additives for the base oil in the emulsions?

** Chief Lubrication Engineer, Republic Steel Corporation*

Editor's note:

Readers are invited to submit further discussion and comments concerning "Emulsions as Hydraulic Fluids."

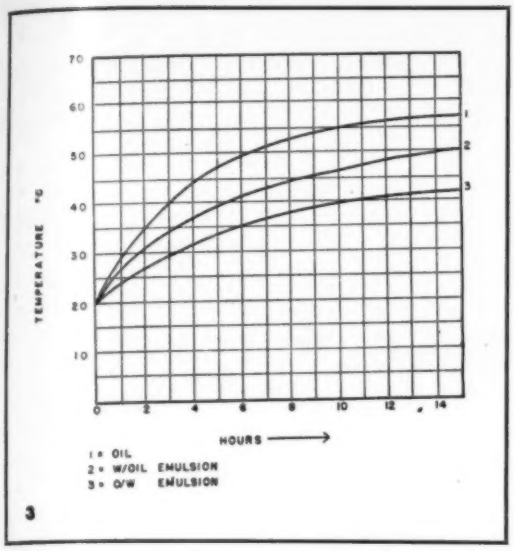


Fig. 1. A gear pump is used having a capacity rating of 32 liters at 1500 rmp and 280 psi. Curves indicate falling output with increased pressure for the noted fluids at the given temperatures.

Fig. 2. Because of wear, the pump output drops as operating time increases. Note the similarity between operating characteristics for oil and an emulsion of water-in-oil.

Fig. 3. As operating time increases temperature rises. The use of emulsions result in a lower operating temperature than do hydraulic oils.

erating time on the output of the pump.

The curves showing the performance of oil-in-water emulsions, indicate a high wear-out of the pump due to insufficient lubricating properties and a decrease of the initial viscosity of the emulsions during the test period. The emulsions did exhibit excellent stability and anti-corrosive properties.

Results shown in Figure 3 indicate that oil-in-water emulsions have a low temperature change with increasing time when the operating pressure is held constant. However, this temperature is still high enough to cause constant and considerable evaporation of water from the emulsion. Resultant problems of corrosion and instability have not been overcome.

Further tests indicate that water-in-oil emulsions exhibit good efficiencies as hydraulic fluids. After 150 hours of continuous operation, there was little change in viscosity and the evaporation of water is reduced compared to the results obtained with oil-in-water emulsions.

Water-in-oil emulsions exhibit the phenomenon that the viscosity increases as more water is added up to a certain limit. A desired operating viscosity may be obtained by the addition of the proper amount of water.

These investigations, still incomplete, show that it is possible to synthesize some substitute hydraulic fluids in the form of water-in-oil emulsions. Although these might still continue to be inferior to normal hydraulic oils, their advantages of decreased fire and health hazard, comparative inexpensiveness, and saving of valuable oils might prove important in case of emergency.

Authors' Closure

1. The formation of water-in-oil or oil-in-water emulsions actually will be determined largely by the emulsifier, although other influences (temperature, concentration, etc.) affect the stability of the emulsion. The point of reversion can be determined: by adding either the oil or water to the emulsion, without stirring; a separation into two phases shows that the internal phase has been added. Addition of the external phase would not cause instability. Emulsion viscosity is controlled by the addition of the external phase.

Another method of determining whether the emulsion is water-in-oil or oil-in-water is to add dyes possessing different solubilities in the water and the oil to the emulsions. Microscopic investigation will show which are the internal and the external phase.

2. Additives can be added to the emulsions to impart increased anti-wear characteristics. However, the additive must be checked to determine its stability in the emulsion. This is a rapid, simple procedure.

3. Water-in-oil emulsions are very stable against evaporation of water. Evaporation of water does not cause a phase change into oil-in-water emulsion, and the fast pumping action has an emulsifying action which prevents breakup of the emulsion during operation. After operation water may be added to bring the emulsion to the desired viscosity by using the pump as an agitator.

4. Tests have shown that the greater the viscosity of the mineral oil, the higher is the viscosity of the final emulsion. An oil of better lubricating properties results in water-in-oil emulsions of better lubricating effect. Extreme pressure additives are very advantageous provided that they are chemically stable in the presence of water.

K. F. H.–M.R.

Packaged units
for simplified design

Let's Do It a Simpler Way!

By G. P. WALKER
Williamson & Co., Inc.
Caldwell, N. J.

IN REVIEWING THE ARTICLE, "Triplex Circuit for a Printing Press Plant"*, we are inclined to believe that the system selected for a 1000-ton matrix press can be greatly simplified by using standard, self-contained and compact hydraulic units. Such units, as the unit described below, greatly simplify the circuit engineering, reduce the piping and installation cost, cut down the power loss due to excessive piping and fittings and encourage good housekeeping.

A schematic, simplified oil circuit diagram, Figure 1, illustrates how a few standard components will perform the functions described in cycles numbers 1, 2 and 3.

This circuit was used on the 600-ton "Platemaster" hydraulic molding press, Figure 1, built by the A. B. Farquhar Co. of York, Pa. for Williamson & Co., Inc. of Caldwell, N. J. Cylinder "A" is of the conventional single acting type. The cylinder diameter is adequate to provide the required tonnage at operating pressures to 3000 psi.

Pump "B" is a standard duplex pumping unit, consisting of a large volume, low pressure gear pump for providing pressures to 300 psi, a small volume high pressure radial piston pump for providing pressures to 3000 psi and a built-in unloading valve which automatically by-passes the large gear pump volume at practically zero pressure when the pressure to the press cylinder exceeds any preset pressure up to 300 psi. The duplex pump is directly connected to an electric motor and mounted on a reservoir base. The duplex pump provides 7000 cipm low pressure volume and 430 cu in high pressure volume when operated at 1150 rpm.

Valve "C", a four-way type, has three positions. In position I, ports one and four and ports three and two are connected; in position II, ports one, four and two are connected; and in position III, ports one and three and ports four and two are connected. In position I the combined volumes of the duplex pump are delivered to the press ram to provide rapid closing of platen. When the pressure exceeds a preset low pressure (to 300 psi), the large gear pump volume is automatically by-passed and the small radial piston pump volume provides and maintains the high pressure, set by the adjustable relief valve "D" on the ram.

Fig. 1. The "Platemaster", a standard 600 ton hydraulic molding press. The valve lever, adjustable control for relief valve and pressure dial are conveniently grouped.

It is essential that the preset pressure at which the large gear pump by-passes be as low as possible. This pressure should be just sufficient to provide sufficient force to lift the weight of the moving parts to insure that the low pressure pump will be by-passed whenever the valve is in position II and the relief valve "G" is set low. This is necessary to be certain that the large volume pump is by-passing at practically zero pressure rather than moving this volume through the orifice "E" and relief valve "G". In other words, the setting of relief valve "G" must be higher than the setting of the by-pass valve in the pump which by-passes the low pressure pump, other

** The article to which Mr. Walker refers is "Triplex Circuit for a Printing Press Plant" published in APPLIED HYDRAULICS, November, 1948. This article described a special arrangement of hydraulic circuit and control to operate three cycles automatically: (1) close press rapidly, hold to predetermined and adjustable tonnage, then open; (2) same closing and hold for predetermined adjustable tonnage, remain closed under pressure for a predetermined and adjustable interval, then open; and (3) same closing, then slowly diminishing of holding pressure until dropped to a predetermined and adjustable low pressure, then open press. Rapid closing is accomplished by a 24 gpm variable volume low pressure pump; high pressure by a 3 gpm piston pump. Both hydraulic and electrical circuit diagrams were shown.*

wise the low pressure gear pump will constantly cut in and out when the valve is in position II, due to the action of orifice "E".

If decompression is not essential, the operator moves the valve plunger to position III and the ram moves downward at high speed by gravity. Oil from the radial piston pump is by-passed through ports four and two, causing low pressure gear pump to be by-passed at near zero pressure through its own by-pass valve. However, good decompression is normally a requirement. At first it was believed that it would be necessary to stop the valve momentarily in the mid-position before opening the press. However, it was found in practice that the normal movement of the valve from one extreme position to the other gave perfect decompression without shock. However, if decompression is desired, the operator moves the valve plunger from position I to position II, permitting more decompression of main cylinder through orifice "E". When pressure has dropped sufficiently, the operator moves the valve plunger to position III and ram moves down by gravity. By leaving the valve control plunger at position I, the operator can maintain the desired pressure on the ram for any desired time.

It is important on modern matrix presses to have an initial low pressure squeeze, especially when molding plastic mats. This initial low pressure is obtained by putting the four-way valve in position II; the pressure obtained is very low approximately 50 psi) as set by the relief valve "G". The duplex pump by-pass valve is then set to by-pass at about 40 psi instead of 300 psi.

Relief valve "D" is adjustable from 50 to 3000 psi and is used to select the pressure to be maintained on the main ram during the holding cycle.

Orifice "E" permits a slow pressure drop for decompression of the oil in the main cylinder. If the decompression period is to be varied, an adjustable needle valve can be used.

Two relief valves "G" and "H" are provided in the line from the exhaust port three of valve "C". Relief valve "G" is used to control the low pressure and is usually set at a low value in order to provide the initial low pressure squeeze. The second relief valve "H" is incorporated in the circuit to protect the cooler in the event it is necessary to open up the orifice "E" to a fairly large opening to provide for more rapid decompression. On the presses we have built to date, it has not been found necessary to use a large opening at orifice "E". Relief valve "H" could be eliminated; however, the cost of this relief valve is very small and we feel it is good insurance.

Comments By Pump Manufacturer

On some matrix presses it is desirable to operate a plate manipulating cylinder from the same system. This is easily accomplished with the addition of a small double acting cylinder, a small four-way non-by-pass type directional control valve and a small relief valve, normally set at 1000 psi. The relief valve is installed directly below the orifice and a branch supply line to the auxiliary four-way valve is connected to the line between the orifice and the extra relief valve.

Some matrix press manufacturers provide a high speed closing rate without the use of a large low pressure pumping unit by incorporating a small, rapid traverse ram built into the main ram or two small auxiliary single acting rams. A single, small high pressure radial piston pump supplies the fluid power for moving the main ram upward at high speeds and maintains the high pressure on the system during the holding portion of the cycle. This type of system is similar to that shown in Figure 1, except that the low pressure pump is eliminated and a hydraulically operated differential valve and two check valves are added.

If a variable delivery high pressure pump is used, the volume can be reduced to a point which will best suit the application. Standard automatic pressure unloading controls are available for each size of variable delivery pump, so that the volume of the pump is automatically reduced to practically zero when the desired preset pressure is reached. This type of control greatly reduces the power input and avoids excessive heating of oil while maintaining the maximum pressure on the system.

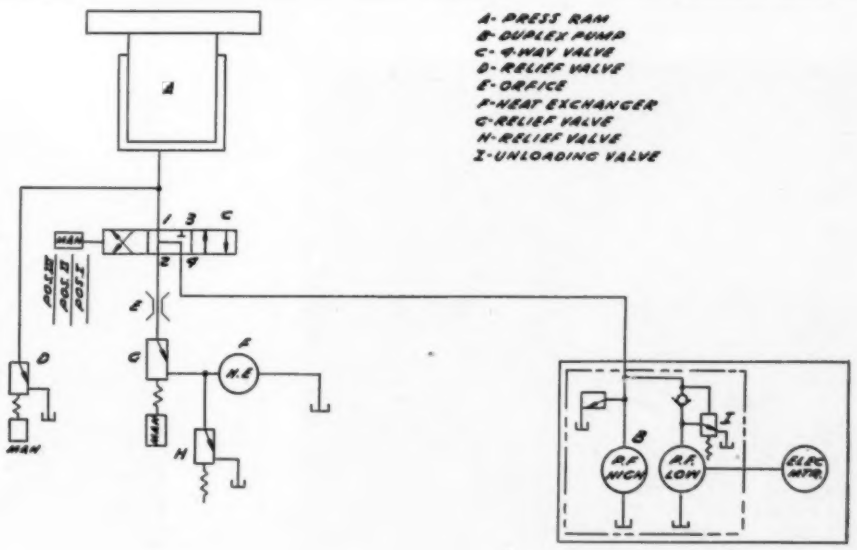


Fig. 2. The hydraulic circuit for the plastic molding press. The duplex pump provides a large volume, low pressure flow for rapid closing of platen. At a preset pressure, the low pressure pump is by-passed and the radial piston pump maintains the high pressure.

Trunnion Mounted Unit Provides 10 Ton Force

DUMP TRUCK GETS A LIFT

TWO HYDRAULIC COMPONENTS, A Gar Wood gear pump and cylinder supply the force for raising the load on a dump truck. The gear pump, Figure 1, is installed on a 1½ ton truck, Figure 2. Operating at 1000 rpm, delivering 800 psi to the hoist cylinder, creates a force of 22,000 pounds. The hydraulic cylinder moves through a 19¾ in stroke as it elevates the truck body to a 55 degree dump angle.

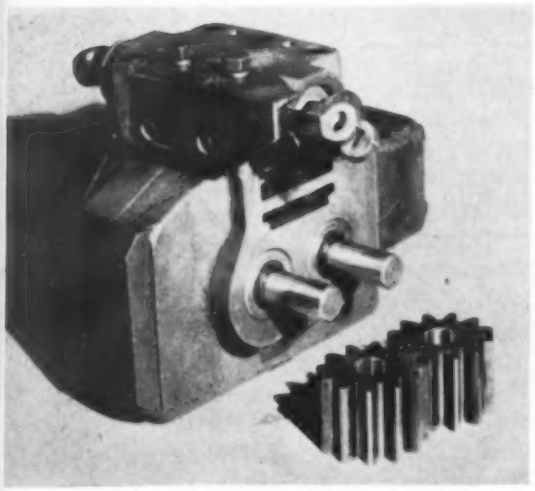


Fig. 1. Gear pump supplies 800 psi to the hoist cylinder.

Figure 2 shows the pump and cylinder mounted on a trunnion type rocking support platform which also takes the thrust of the hoist during dumping operations. A separate power take-off gear enclosed in the truck transmission drives the pump through a telescoping drive shaft and universal joint. It is operated using the regular truck clutch pedal to stop transmission gear rotation during the engagement of the power take-off gear.

Rotation of the hoist support bracket about its axis as the truck body is raised and lowered necessitates the use of a slip-fit splined sleeve and shaft to take up the changing distance between transmission and pump gear shaft. The shorter section of the universal joint is keyed directly to the pump gear shaft.

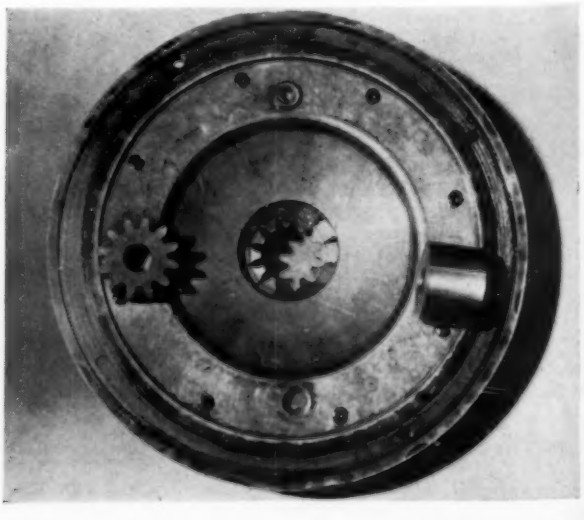
Double gear shafts shown on the pump provide an interchangeable drive hook-up for either left or right hand drive shaft rotation, since either may be the "driven" gear.

The spool type valve at the top of the pump housing has three operating positions—"extended" for raising the truck body, fully "in" for lowering and "centered" for holding the truck body at a given angle. A mechanical linkage actuates the valve. The valve spool areas in contact with fluid under pressure are equal in all spool positions to maintain hydraulic balance of the unit, preventing creep of the spool with resulting undesirable movement of the hoist and truck body.

To produce the pump, Gar Wood Industries uses a gear cutting process developed by Michigan Tool Co., Detroit, which form cuts all teeth simultaneously. Figure 3 shows a worm's eye view of the "Shear-Speed" cutting head, together with the finished gear and blank. The head is automatically lowered to a point just above the work. The tools feed in radically, a small amount, each time the work is reciprocated up and down through the head, until full tooth depth is reached. An "underpass" shaving operation finishes the gears to within .0003 in.

Fig. 2. Pump and cylinder are mounted to a rocking platform on the truck frame.

Fig. 3. View of cutting head for shaping all gear teeth simultaneously.



Stepping Up Pen Barrel Grinding

By R. O. McKINNEY
Tool Design Department
Parker Pen Company

At the Parker Pen Company of Janesville, Wisconsin, a simple, economical installation of an air circuit to operate an automatic magazine feed on a centerless grinder has increased production 36 per cent on a finish grinding operation. In addition, this setup gives the operator sufficient time to gauge and inspect the parts continuously. Previously, hand operation required a skilled operator and a down time allowance to permit inspection of the parts.

Figure 1 is a closeup of the magazine feed mechanism. The arbor, shown in the retracted position, moves forward by the action of the air cylinder to pick up a pen barrel from the magazine.

Directly below the air cylinder, a solenoid operated air valve is mounted. This valve, being the control device for the system, is truly the heart of the design. The valve, which controls the speed of the stroke in both directions makes the design of an air circuit for this application superior to any mechanically operated tooling. Each machine is set to operate at 1440 cycles per hour.

Figure 2 is a schematic representation of the circuit. The operator places the parts in the magazine "J" and from then on the operation is automatic. When the infeed attachment and front profile wheel "G" opens, the ejector cam "C" trips micro switch "D" closing the electrical circuit "B" and energizing the solenoid in the control valve "N". Air supplied from line "L" through the air regulator and filter-lubricator "H" passes into the head end of air cylinder "K". Arbor "H" which is an integral part of the cylinder piston rod, moves forward with a pen barrel from the magazine.

With the barrel on work rest "F", infeed attachment "G" closes, releasing micro switch "D" and air valve "N". The piston and arbor "H" are retracted as air enters the rod end of the cylinder. The grinding operation is performed between profile wheels "A" and "G". As infeed attachment "G" again opens, the pen barrel is ejected by "E" when ejector cam "C" trips the micro switch to repeat the cycle.

By adjusting the locknuts on the valve, air flow is controlled to provide slow infeed and rapid return.

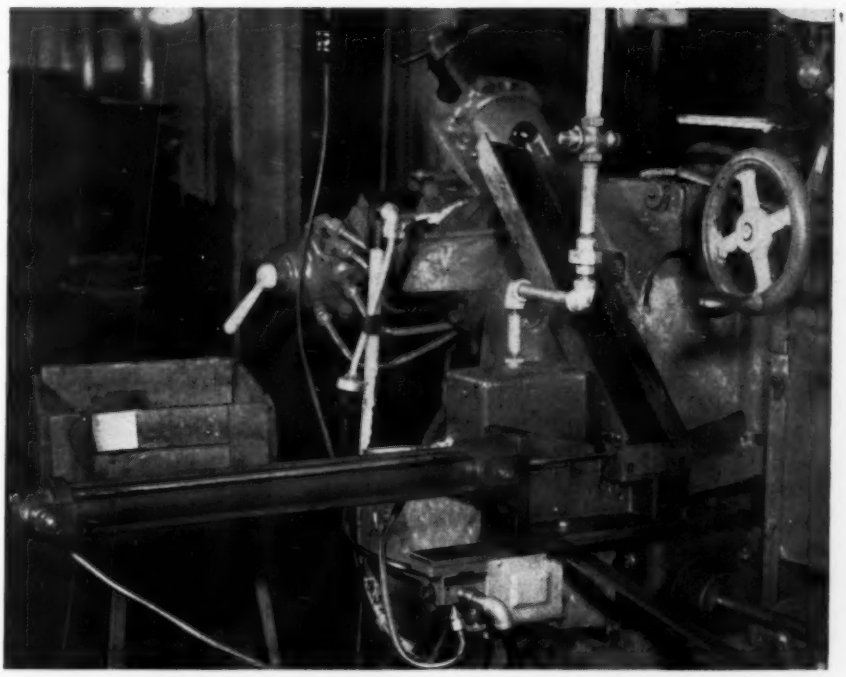


Fig. 1. The four-way air valve, mounted below the air cylinder, controls the speed of the arbor as it moves forward to pick up a pen barrel from the magazine.

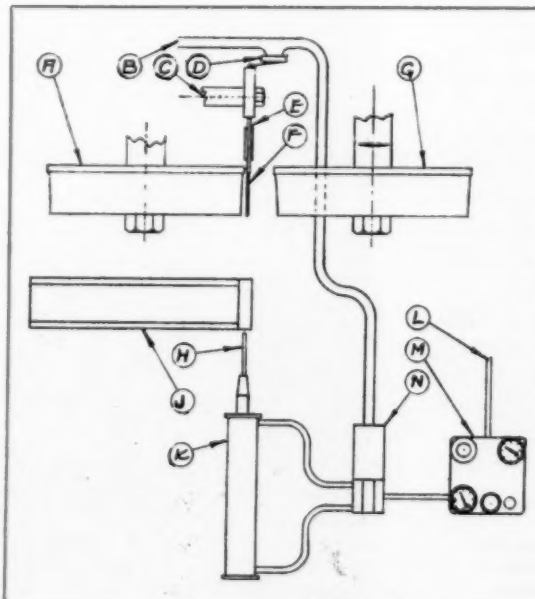


Fig. 2. The cycle starts when the infeed attachment opens causing the ejector cam to trip a micro switch which closes the electrical circuit and energizes the solenoid in the control valve. Air enters the head end of the cylinder and imparts motion to the arbor. When the infeed attachment closes, the circuit is deenergized and the arbor is retracted.

FRED O. HOSTERMAN
Advisory Editor

61S ALLOY TUBING
For Hydraulic Pressure Systems

By G. A. FAIRBAIRN
Process Analyst

J. J. SLOAN
Production Design Engineer
North American Aviation, Inc.

THE WIDESPREAD AVAILABILITY OF 61S aluminum alloy tubing for industrial use has brought about its consideration for aircraft use. In doing so, the advantages of the alloy as a practical compromise between the relative weights of steel and aluminum, its superior corrosion resistance to that of 24S alloy and its high workability are utilized. This alloy has been accepted by several aircraft companies for general use in all aluminum alloy tubing applications including hydraulics.

The 3000 psi hydraulic systems in commercial and military aircraft usually employ ¼, $\frac{5}{16}$, ⅜, ½ and ⅝ in diameter lines. The tubing used for such hydraulic pressure lines has generally been heat treated 24S aluminum alloy or 18-8 type stainless steel in approximately ⅛ hard temper. The 24S alloy tubing is purchased to specification AMS4086 and stainless steel tubing to AMS-5566. Both specifications were written expressly to cover hydraulic line tubing. 24S alloy tubing has the advantage of a higher strength-weight ratio than stainless steel tubing but has the disadvantages of being difficult to flare and of being susceptible to intergranular corrosion.

Provision for connections between lines is made by flaring the ends of the tubing and assembling with end fittings consisting of an AN819 sleeve and AN818 nut. The flarabil-

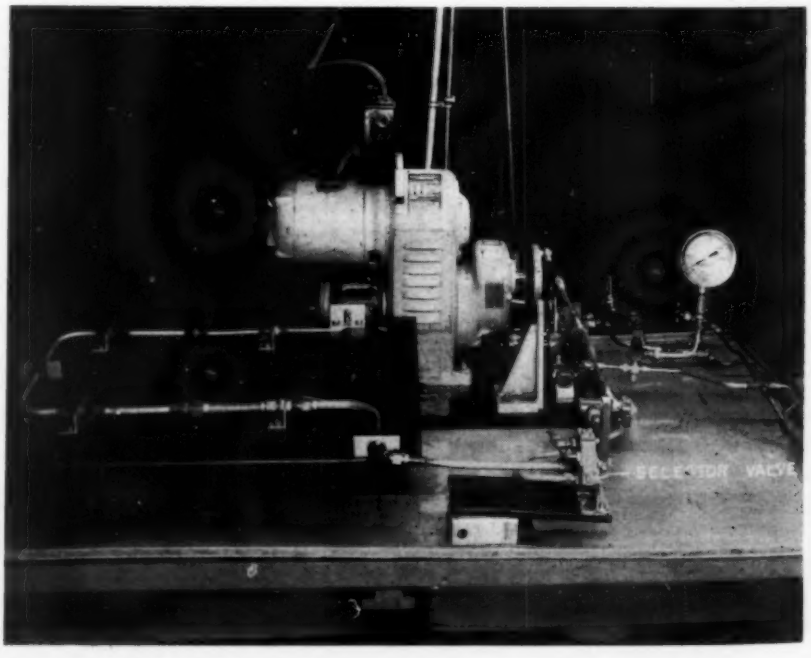


Fig. 1. The test set up for the pressure impulse tests of 61S-T6 aluminum alloy tubing.

Material	Spec.	Tensile Ultimate	Tensile Yield 0.2% Offset
Stainless Steel	AMS5566	105,000 psi	75,000 psi
24S Aluminum	AMS4086	64,000 psi	42,000 psi
61S Aluminum	AMS4083	42,000 psi	35,000 psi

Table I. Minimum tensile properties for tubing materials.

ity of 24S tubing is such that flaring must be done in the annealed (24S-O) or freshly quenched (heat treated) conditions. The latter method is preferred as heat treatment after flaring is undesirable.

In view of the disadvantages of 24S tubing, it was considered desirable to investigate the possibility of 61S aluminum alloy tubing for hydraulic line applications. Being in general commercial usage, 61S alloy tubing is available in a wide assortment of sizes. The material is known to have excellent corrosion resistance and good workability, yielding a low rate of work hardening. Although the strength of fully heat treated 61S tubing is less than 24S, its strength is sufficient to give a higher strength-weight ratio than stainless steel tubing. 61S tubing for hydraulic line applications is available in the fully heat treated condition (61S-T6) under specification AMS4083. The minimum tensile properties required by the applicable material specifications for 24S, 61S and stainless steel are given in Table I.

In order to evaluate 61S material for use in 3000 psi hydraulic systems, samples of 61S-T6 tubing were subjected to burst pressure and pressure impulse tests. Tubing in ¼, $\frac{5}{16}$, ⅜, ½ and ⅝ in diameters was tested. The test requirements were: (1) the tubing must not burst under a hydraulic pressure equal to four times the system pressure or 12,000 psi, and, (2) the tubing must have an endurance life of 200,000 cycles when subjected to pressure impulses of 100 to 3000 psi at a rate of at least 30 per minute, with dynamic surge pressures permitted up to 4500 psi. Figure 1 shows the set up for the pressure impulse tests. The results from these tests indicated that the 61S-T6 tubing was suitable for use in 3000 psi hydraulic systems.

Figure 2 shows typical failures which occurred during burst testing ⅜ in diameter tubes and Figure 3 shows a failure in ¼ in diameter tubing under pressure impulse. In preparing samples of 61S tubing for these tests, it was found that the flaring operation on fully heat treated tubing produced small longitudinal cracks on the outside surface of the tubing at the end of the flare. No failure in any flare occurred at any time during testing due to these cracks and no leakage occurred. As a result it was felt that these cracks were of no consequence provided that they did not extend into the fillet area where the flare joins the straight section of the tube. Subsequent experience with 61S tubing in production has supported this belief.

In the fabrication of hydraulic lines, flaring at each end and bending are the limiting operations, i.e., high strength aluminum alloy (24S) cannot be flared except in annealed or freshly quenched condition. 61S-T6 can be flared in the fully heat treated condition, and bend radii are at least as good for 24S-T3 or the stainless steels used in hydraulic systems.

The flaring operation requires, first of all, a good "burr job". The burring tool should square up the end with respect to the center line and scrape a chamfer on both inside and outside. The widths of flats should be approximately equal on all three surfaces—end and chamfers.

Flaring Methods

Flaring is performed by two different methods, depending on size. In sizes ¼, $\frac{5}{16}$ and ⅜ in OD 61S-T6 the flare is produced by upsetting and conforms to specification AND-10078, the so-called "double flare". Actually, it is not a "double" flare; a glance at Figure 4, which shows the successive stages in the operation, will indicate that the edge of the tube (the end) is hardly stretched at all. This allows much more severe forming than would be possible with the free edge.

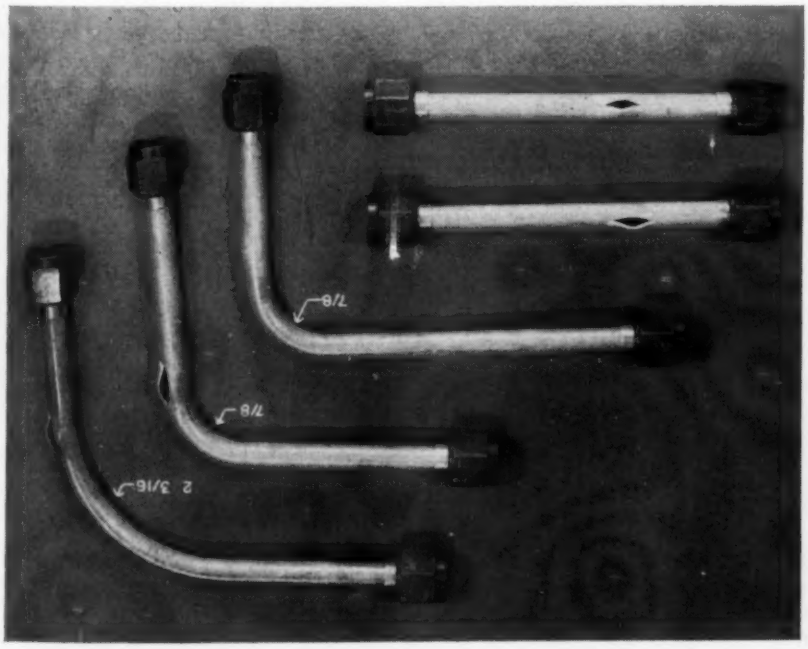


Fig. 2. Typical failures on burst tests of ⅜ in diameter tubing.

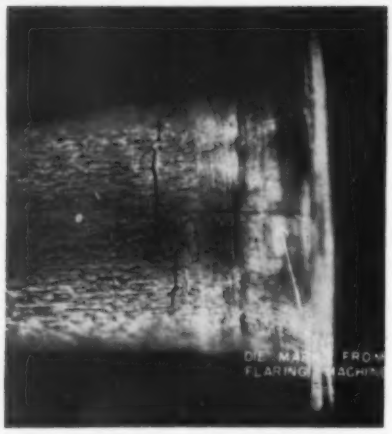


Fig. 3. A failure in a ¼ in diameter tube under pressure impulse. The die marks that extended into the fillet area were responsible for the failure.

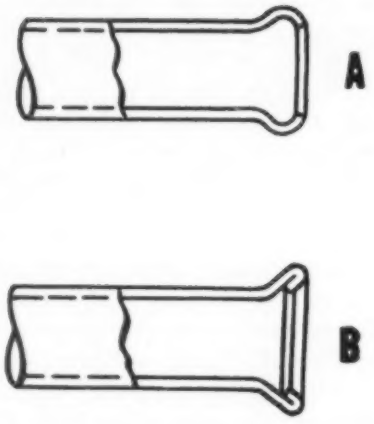


Fig. 4. The two operations in forming the "double flare". The two stages stretched the edge of the tube very little, allowing a much more severe forming than possible in the free edge.

This type of flare is formed on a specially designed double flaring machine. Its essential elements consist of a set of four serrated jaws to grip the tube, a flat punch to upset the tube end and a conical punch to finish the operation, together with the necessary motor, air cylinders and other mechanism.

Sizes ½ in OD and up can be flared in the T6 condition to specification AND10061. This type is a co-called "single" flare and is produced by rolling. An eccentrically mounted punch of conical shape rolls around the rim of the tube end, pressing it outward against a female die. A roll-flaring machine, with interchangeable punch and die sets to handle a number of sizes, forms the flare.

In single flaring ½ in diameter tubes the elongation is about 25 percent, admittedly high for 61S-T6 alloy, but of a local nature. The types of cracks which occur in flaring this size are of three general classifications. The flowering type of burst flare is definitely a cause for rejection. Surface defects on tubing such as small pits, folds and die marks which are apparent in a definite pattern or longitudinal line along the OD will cause rupture, but in many cases not entirely through the wall. Receiving inspection eliminates the majority of this type of surface condition before detail manufacture of lines is begun and vendors are improving the surface quality of their tubing toward the same objective. The third type of crack is a small surface rupture, perhaps ¼ of the wall thickness in depth and ranging in length up to $\frac{3}{32}$ in from the mouth of the tube. This type of crack was present on samples subjected to the tests. In production, no cracks of this nature have opened up to extend through the wall and none have leaked under pressure.

Table II charts the minimum straight lengths desirable for the two flare types, based on standard tool requirements and using the AN standard sleeves and B-nuts.

Bend radii used for bending 61S-T6 tubing are the same as those in use for 24S-T3 or stainless steel lines. It is possible to substitute 61S alloy for either 24S or equivalent specification without affecting templates already made. The bend radii are given in Table III, measured to the inside of the bend. It is customary to place a definite limit to the maximum out of round dimension applied to the tube in the circumference of the bend such as 6 percent of the OD. Wall thicknesses used for 61S-T6 are thicker than either steel or 24S-T3 of equivalent diameters. This is a distinct help in bending.

The use of 61S alloy tubing in other than hydraulic pressure lines has both advantages and limitations. The low or no-pressure return lines, fuel vents, overflow pipes, etc., are generally best fabricated using 61S-O or 61S-T4. Due to its excellent corrosion resistance in all tempers, 61S alloy may be used in annealed or as quenched conditions and does not have to be fully heat treated if strength requirements do not warrant it. Beading (AND10060) by the usual rolling method is not practical for T6 condition, but acceptable beads can be produced by upsetting. For this, the first operation in double flaring (Figure 4) is performed. 61S-O and 61S-T4 can be beaded by rolling in all sizes. Other operations like spinning ends closed or flattening can be performed with similar results to those obtained with 52S-O alloy by using annealed 61S.

OD	Single Flare AND10061	Desirable Minimum for Double Flare AND10078
1/7	1	2 1/2
3/16, 1/4	1	2 9/16
5/16	1 1/8	2 9/16
3/8	1 1/8	2 5/8
1/2	1 1/4	
5/8, 3/4	1 1/2	
1	1 3/4	
1 1/4	2 3/8	
1 1/2, 1 3/4, 2	2 1/2	

Table II. Minimum straight length for flaring.

Diameter	Bend Radius
1/4	3/4
5/16	3/4
3/8	1 1/2
	1
1/2	1 3/4
	1 1/2
5/8	2 1/2
	1 3/4
3/4	3
	2 1/2

Table III. Bend radii of sizes of 61S-T6 alloy tubing.

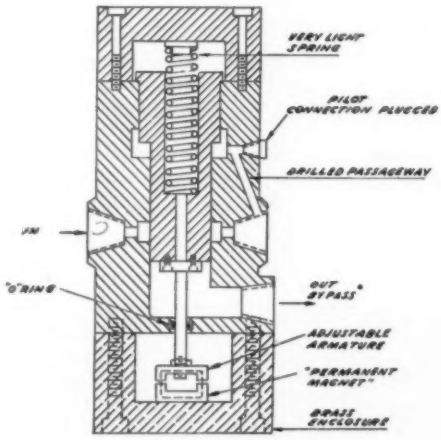
HERE'S HOW

- PREVENTIVE MAINTENANCE
- SERVICE PROCEDURES
- MODERNIZATION
- SHORT CUTS

Magnet Unloads Valve

THE PROBLEM OF HOW TO MAKE AN UNLOADING VALVE unload a hydraulic pump without using an external and remote operating pressure stumped the experts until we hit on this idea.

The method uses a standard unloading valve to which is attached a brass enclosure in which there is a small permanent magnet. The pilot port is connected to the main flow port by drilling a small hole; the port is then plugged. A brass base is made to accommodate a rod, sealed by an "O" ring, and on the end of the rod is a small soft iron armature which is adjustable for the required magnetic air gap. A stationary magnet is mounted in the brass enclosure. A very light spring is used in place of the original one, and is used to compensate for the plunger friction.



The fluid acts on the differential area of the plunger, and at the corresponding setting of the magnet armature, the hydraulic force overcomes the magnetic force of attraction, and the plunger moves rapidly upward and the fluid flow is by-passed. Because the magnetic force of attraction decreases with the square of the distance, the plunger moves to the full open position rapidly and there is very little force acting; thus the pump operates at practically zero hydraulic pressure, as in a conventional unloading valve.

ROLAND STRONG
Schenectady, N. Y.

Checking Air Leaks

On page 12 of your April issue one of your correspondents mentioned that he had used a method for checking air leaks that you had printed in January. I wonder if I could get a tear sheet covering the article he mentioned.

C. W. G.
New York, N. Y.

The reference was to the item "How to Isolate the Cause of Leakage Through Valves" which was printed in this department in January, 1950. A tear sheet has been mailed to you.

Suppressing Hydraulic Line Shock

WATER HAMMER, or hydraulic line shock, often results from rapid closure of a valve in a hydraulic system. Once started, the hydraulic shock wave cannot be stopped until the energy is dissipated by friction and the flow is eventually stopped. These shocks have resulted in pipe failure and damage to valves, fittings and gauges. To prevent or minimize water hammer requires a method of easing sudden and large rates of deceleration of the fluid column. Hydro-pneumatic accumulators have proved effective in the reduction of line shock for a variety of applications. When the flow in the system suddenly stops, the accumulator acts as a surge chamber to absorb the resulting shock or impact.

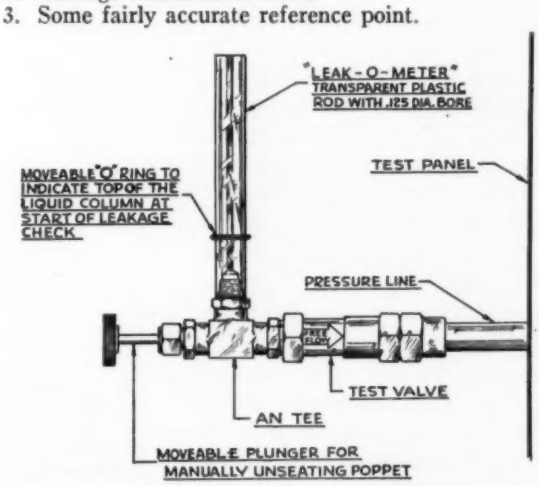
MIKE PHILLIPS
Brooklyn, N. Y.

Leakage Test for Valves

OBTAINING A USEFUL LEAKAGE RATE READING ON HYDRAULIC valves is complicated by variations in viscosity, temperature, surface tension and vibration which make improbable a constant reading from one test to the next.

The "Leak-O-Meter" was developed to meet the following minimum requirements:

1. Retention of the leakage as it occurred without losses such as would result from lubrication of flow paths to the drip point.
2. Leakage visible at all times.
3. Some fairly accurate reference point.


"LEAK-O-METER" TRANSPARENT PLASTIC ROD WITH .125 DIA. BORE
TEST PANEL
MOVEABLE "O" RING TO INDICATE TOP OF THE LIQUID COLUMN AT START OF LEAKAGE CHECK
PRESSURE LINE
TEST VALVE
AN TEE
MOVEABLE PLUNGER FOR MANUALLY UNSEATING POPPET

By providing an actual measurement of leakage in cubic centimeters, the device eliminates the problem of defining a "drop" which has been a very elusive measuring stick.

This unit was first used for checking leakage on a manual check valve. Reference to the specification required that the poppet be manually moved from the seat just prior to each leakage test. This did not present any problem, but when a group of normal check valves required testing, there was need for an actuator to permit movement of the check valve poppet from its seat. The illustration shows the use of a tee fitting and a plunger manually operated for this purpose.

RUSS BLAKE
Burbank, California

Readers are invited to contribute their short cost and labor saving shop or plant ideas. Each contribution will be acknowledged and considered for publication. We will pay $5.00 for each item published. —*Here's How Editor*

Design steps in the development of an all welder using remote current control

OIL CONTROLS WELDER CURRENT

By G. K. WILLECKE
Technical Advisor
Miller Electric Manufacturing Co.

SOME WELDING APPLICATIONS require remote and rapid control of current. The Miller Electric Manufacturing Co., Appleton, Wisconsin has chosen to provide this control for "Heliarc" welding by moving the primary coil of the welding transformer with a hydraulic cylinder.

Alternating current transformer type welders are of two broad and general categories. One type makes use of a constant potential step-down transformer which reduces the usual 220v or 440v industrial line voltage to a value between 50 to 90 volts suitable in the arc welding application. The welding current is then limited by a variable inductance connected in series with the welding load. The main objection to this type of current control is that, perhaps due to wave form distortion, the welding characteristics frequently suffer.

The other type of alternating current arc welder also makes use of a transformer to step down the line voltage to the arc requirements but it is not of the constant potential type. The transformer is specifically designed to have poor voltage regulation due to high leakage reactance. Current control is achieved by a variable, mechanical displacement of the primary winding with respect to the secondary.

In this type of machine, the primary coil is generally moved with the aid of a screw and crank arrangement for manual operation. Careful experimentation has shown that a screw pitch of six threads per inch and a crank radius of approximately six inches seems a fair compromise from the standpoint of operating ease and speed, and reasonable design.

While welding characteristics of such a standard machine are excellent, rapid current control is unattainable. Motor drive of the operating screw does provide remote control but does not lend itself to rapid current control. Any attempt to increase the operating speed would necessitate unreasonably large driving motors and bring about all the troubles that go along with gears and other components rotating at high speed.

After careful analysis of the problem, the following requirements were set-up:

1. The primary coil, weighing roughly 100 pounds, had to be moved a vertical distance of 17 inches in approximately five seconds.

2. No change in the welding characteristic from that of the manually operated moving primary type of machine could be tolerated.

Fig. 1. Front view of the complete welder shows the control switches plugged in. The foot switch (left) controls the gas and water flow. The hydraulic control switch is the larger of the two.

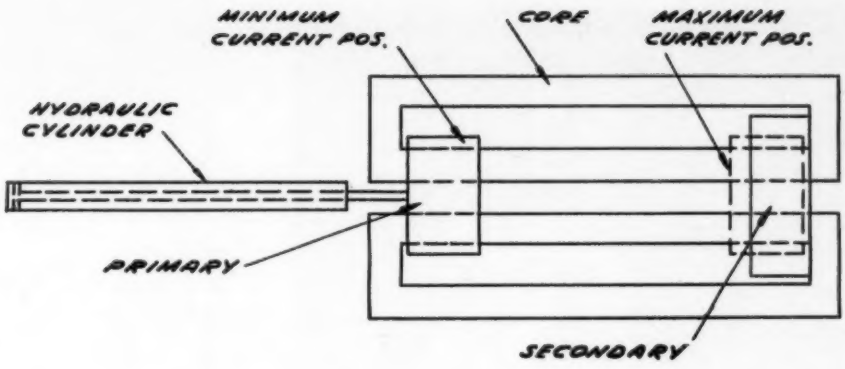


Fig. 3. Diagram of the basic operating principle of the moving coil transformer type welder. The secondary remains fixed in position while the moving primary coil, positioned by the cylinder, provides current control.

3. The control system should be completely self-contained, and had to be fool-proof and reliable in operation.

Hydraulic operation of the primary coil movement could readily meet all of the requirements but the cost factor seemed almost insurmountable. The first thought was to compromise and use an air cylinder, since most plants have compressed air available, and thus save the cost of a pump and motor.

This gain was weighed against the cost of losing the feature that the system should be self contained and the idea of air operation was given up.

The second attempt at economy was to use a quick reversing motor driving a reversible pump operating directly into a double acting hydraulic ram. An experienced hydraulic engineer could have pointed out the various pitfalls of sluggish starts and stops, locking and other troubles that appeared in the first experimental model.

Finally a readily available commercial power unit consisting of a pump, valves and reservoir was utilized.

In choosing the hydraulic activator it was necessary to review our fundamentals of hydraulics. The force available for external work is the product of the operating pressure times the piston area. With a 1.5 in bore cylinder we could easily secure adequate force at reasonably low pressures.

The speed of the piston is a function of the flow capacity of the system which, in the final analysis, depends upon the pump capacity and the driving motor. Since piston speed times area equals pumping speed, it is obvious that the speed of the piston, if there are no impediments in the flow line and the pump is not operated beyond capacity, depends directly on the power rating of the driving motor.

In the case of the standard double-acting hydraulic ram there is also a difference in the force applied on opposite sides of the piston. This is due to the fact that the operating rod reduces the area on which the pressure can act. If the rod is extended this difficulty is eliminated at the expense of increased space requirements. Concomitant with the decreased force, there is, however, an increase in operating speed due to the decreased volume on one side.

Since plenty of force was available to move the coil up or down the only concern was the difference in speed. Fortunately, this worked out very well since the minimum current position is with the coil at its highest position and the hydraulic cylinder at its minimum extension. This is shown in Figure 2 which is a diagram

Fig. 2. Rear view, with access door open, shows details of construction and location of various parts. The hydraulic cylinder extends above the core of the welding transformer.

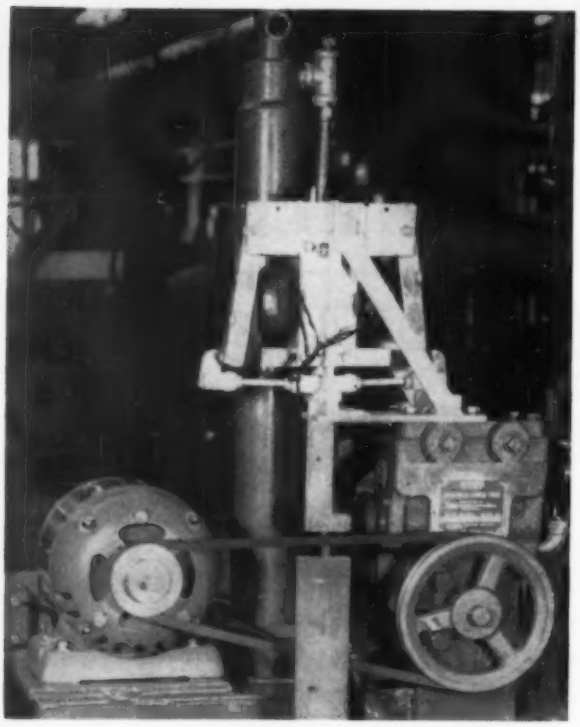


Fig. 4. Complete assembly of the power system shows the details of the link coupled control system. A commercial hydraulic power package is used. Clapper type electrical actuators control the valves.

of the basic transformer. If there is to be any preference to operating speed, the more rapid current decrease is desirable. Simple calculations show that, in our cylinders, the upward travel should be made in 90 percent of the downward time.

Our calculation showed that a ½ hp motor should be sufficient to operate the hydraulic system at optimum speed.

The correctness of the design is shown by the fact that in the actual machine the range from minimum to maximum welding current is covered in 5.0 seconds while the reversed range takes only 4.5 seconds.

The operating valves of this particular power unit require a ⅝ inch travel for maximum operating speed. Manual operation of these valves was out of the question since electrical remote control was desired so that the system could be tied in with existing control circuits.

Solenoids are apt to give trouble due to sticking if operated in dirty locations and especially if horizontal operation is desired. It was found that some clapper type electrical actuators, that had been designed for other purposes, could be readily modified and link-coupled to the valves. The coils are operated at 115 volts a.c. since this is readily available in the machine as a control voltage. The electrical valve operating assembly is extremely rugged and reliable in operation. It is especially easy to get at should service requirements make this necessary.

Current through the coils is controlled through two sets of control switches. Two push buttons, marked "increase" and "decrease", are located on the front of the case and provide local control of the coil position. A foot switch (or two micro switches on the torch handle) can be plugged into the circuit to take over control. An interesting point is that the local push buttons have preferential control. This feature prevents simultaneous activation of both coils. To prevent over-travel of the primary coil, limit switches are placed in series with the coil and are operated by an arm attached directly to the moving primary coil.

Setting Coil Position

Position of the limit switches makes them easily accessible so that they may be changed to suit the operator. A switch is provided on the front panel to control the motor of the hydraulic system. If the machine is to be operated at a constant setting for any length of time, the coil can be set and the hydraulic control system turned off. The primary coil will stay in position.

The control system, as constituted at the present time, does not provide for variable speed control of the welding current. The operation, however, is very smooth and the operator can "inch" the coil by proper use of the foot switch. Several methods are being investigated at the present time to provide a variable time rate of current control.

Additional cam-operated limit switches can be located at various positions along the path of coil travel and can be used to control other functions of the welding cycle.

This machine is specifically designed for "Heliarc" welding, a process of welding non-ferrous metals under an inert gas shield. The standard control panel which is normally supplied with regular "Heliarc" machines can be used with this hydraulic machine with no changes whatsoever. This panel controls the preflow of shielding gas, the coolant flow and the idling voltage. Since all of these operations are carried out with relays and electrically operated valves it is quite obvious that the simple hydraulic control can be tied in very easily.

Support For Coil

Converting to a hydraulic unit presented a problem that was not anticipated immediately. In the manually operated machine the lead screw is actually used as a coil guide since it is firmly anchored in bearings at top and bottom. A different method of guiding the primary coil had to be found. The method finally adopted consisted of making use of the core edges, encased in accurate angle iron, as a track on which spring loaded brass shoes could ride. These shoes were made part of the primary coil form. This design resulted in a solid and quiet coil mount with a minimum of frictional losses.

The hydraulic system is definitely not a cheap method of current control but it does offer advantages that generally cannot be obtained any other way. It is therefore not to be assumed that the system can be added to the average or low cost welding transformer and be in competition with manually operated transformers.

It has its applications in specialized "Heliarc" welding where excellent welding characteristics are of paramount importance and rapid remote current control is required.

The term "Heliarc" is a trade mark of the Linde Air Products Company.

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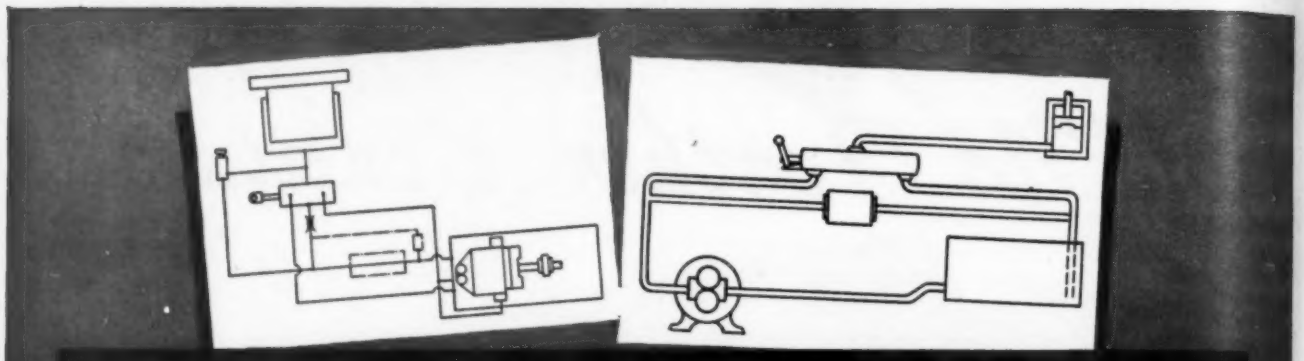

A Beginner's Course in Basic Hydraulics

CHAPTER VII

DIRECTIONAL VALVES

Part 2

Closed and Open Center Spool Valves

Closed Center Spool Valves. Four-way valves may be operated by four different methods: manually, mechanically, hydraulically (pilot) and electrically (solenoid) or by various combinations of these methods. We will limit ourselves to manual and mechanical operation in this case.

In closed center valves the piston is solid and all passages through the valve are blocked when the piston is centered in its cylinder (Figures 89, 90 and 91). In open center valves, the spools on the piston are slotted or channelled so that all passages are open to each other when the piston is centered, as in Figures 92, 93 and 94. In some open center valves, as will be discussed later, passages to the work cylinder are blocked when the valve is centered, while liquid from the pump is carried in bared passages through the piston and out the other side of the valve to the reservoir, as in Figure 95. In valves of this type liquid must be carried to both ends of the piston of the directional valve to keep it balanced, i.e., to A and to B in Figure 95. Instead of discharging into the reservoir when the valve is centered, liquid may be directed to other valves so that a set of operations may be performed in sequence.

Closed center valves are used when a single pump or accumulator performs more than one operation, and where there must be no pressure loss in shifting the direction of stroke at the point of work.

Open center spool valves. Open center valves are used when the work cylinder does not have to be held in position by pressure, and where the power is used to perform a single operation. Open center valves avoid shock to the system when the valve spool is moved from one position to another, since in the intermediate position pressure is temporarily relieved by the passage of liquid from the pump directly to the reservoir. For this reason, reversal of action is smooth.

(Continued on page 38)

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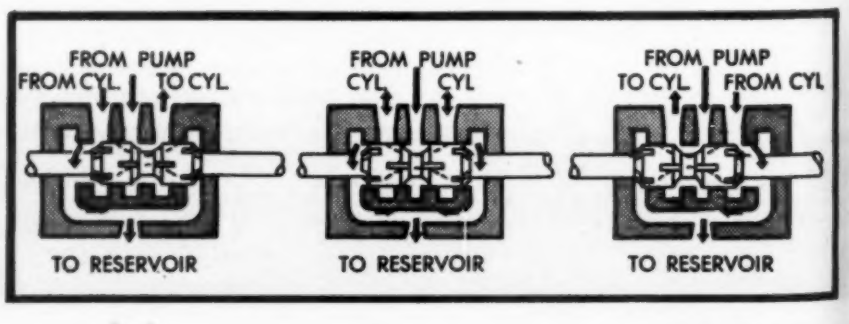
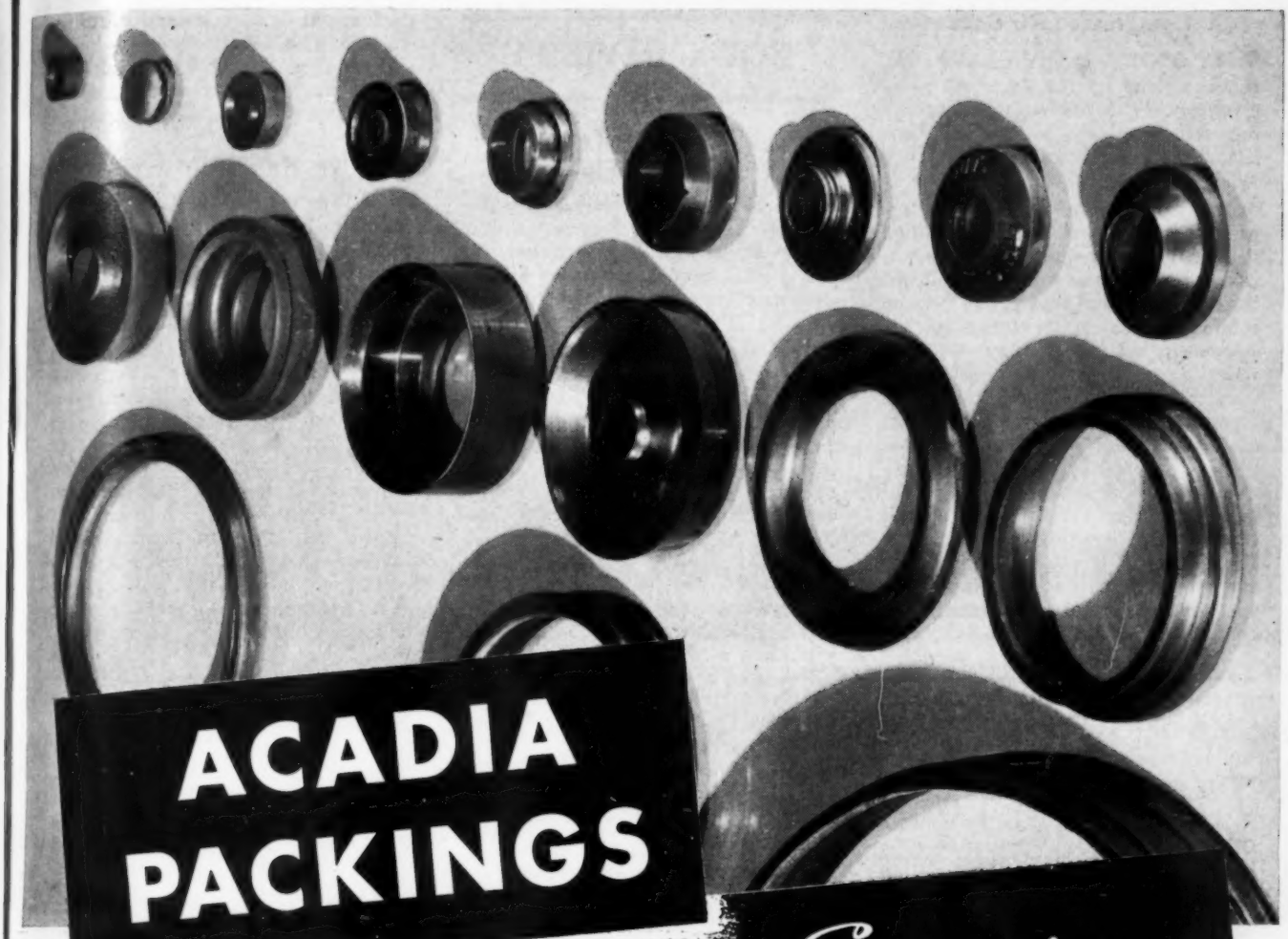


Figs. 92, 93 and 94. Operation of open center four-way valve. When piston is centered (Fig. 93) all passages are open to each other; when piston is to right (Fig. 92) liquid flows from pump to left end of cylinder and right end is open to drain; when piston is at left (Fig. 94) flow conditions are reversed.



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Compressed Air Data

F. W. O'Neil, *editor, assisted by the technical staff of the Ingersoll Rand Company. Fifth edition, third reprinting. 408 pages, 4½ x 7 inches. Published by Compressed Air Magazine. Price $3.00.*

The handbook of pneumatic engineering practice is well established in its field and contains in well organized form the most complete body of basic technical and engineering data on compressed air to be found in one convenient volume. Chapters on theoretical compression of air, boosters and vacuum pumps, turbo or centrifugal blowers and compressors, installation of compressors, pumping with air, belting and application and performance are practical for the service or maintenance man as well as the air equipment designer or engineer. Other chapters on aftercooling, intercooling and reheating, cost of compressed air, and tables and data give an idea of the comprehensive scope of the handbook.

BOOK REVIEWS

Petroleum-Type Hydraulic Fluids

American Society of Lubrication Engineers, *Educational Committee, Professor D. D. Fuller, Chairman; 51 pages, 5½x8 inches. Published by The American Society of Lubrication Engineers.*

This booklet presents the users of hydraulic equipment, maintenance personnel and design engineers with the requirements and specification for hydraulic oils. Emphasis is placed on the importance of hydraulic oil service properties when choosing the proper fluid for the given operating conditions. Each of the properties: viscosity, viscosity index, demulsibility, oxidation stability, lubricating value and corrosive resistance are fully defined. Their application and effect on the operating efficiency of the circuit components are stressed. The determination of typical hydraulic oil specifications, such as, gravity, flash point, acid number, carbon residue and pour point, is discussed.

Design of Machine Elements

M. F. Spotts. *Associate Professor of Machine Design, Northwestern University. 402 pages, 6¼ x 9¼ inches. Published by Prentice-Hall, Inc. at $6.65.*

The plan of this manual is an attractive one for practical engineers—it is a source book in which each chapter is complete in itself. It is also used as a text book. Springs, clutches, brakes, ball and roller bearings, spur, helical, bevel and worm gears, other and miscellaneous elements are covered. Lubrication is adequately discussed. The theoretical side is also covered—theory of torsion, stress concentration and repeated loadings. The final chapters discuss dimensioning, detailing and materials.

Servicing Procedure For Hydraulic Systems

THE PLANT SUPERINTENDENT OF a nationally known manufacturer recently sent a bulletin on the servicing of hydraulic systems to all department foremen pointing out the physical requirements of oils to be used and the service required by hydraulic systems to assure satisfactory operation. With permission, we are glad to pass along to our readers the suggestions made in this bulletin.

Requirements

To operate properly in a hydraulic system an oil should:

(1) Provide just the right seal for the pump
(2) Permit a minimum of wear on working parts
(3) Not change the viscosity with change in temperature
(4) Be resistant to foaming or aeration
(5) Precipitate no gums or sludge
(6) Have no corrosive action on metals
(7) Retain all its properties in use
(8) Give long service life.

Experience has shown that the use of ordinary lubricating oils may result in scored or broken pumps, gumming of control valves, sludging, high operating temperatures, foaming, sticky valves, rapid wear, sluggishness when cold and rust.

Maintenance Procedure

As experience has shown that replacement of hydraulic oil is often neglected even after long service or external contamination has rendered it unfit for further use, periodic cleaning of hydraulic systems is essential to sustain suitable operating conditions for the interior surfaces of pumps, pipe lines, control valves, cylinders and reservoirs. Only in this way can full efficiency of the hydraulic system be maintained continuously and shutdown be avoided.

Periodic inspection of strainers and filtering elements is important. This should be done monthly. Strainers should be cleaned. Filtering elements should be renewed, if necessary. The condition of the oil in the system should also be checked and if there is any evidence of contamination, foaming, sludge in reservoir, sticking valves or discoloration, it should be changed. Otherwise it should be changed after 5000 hours of machine operation.

Changing Oil

The system should be cleaned by flushing with an oil that combines flushing, solvent and lubricating properties in correct proportion for the purpose.

The sequence of operations is as follows for changing oil:

(1) Drain the used hydraulic oil
(2) Inspect and clean the reservoir. Use gum solvent oil and a brush to clean sides and bottom. Do not use a cloth for cleaning or wiping. This may leave lint on the surfaces.
(3) Fill the reservoir with gum solvent flushing oil
(4) Run the pump, not operating the controls, for one-half hour. Then operate control valves, with no work going through the machine for at least an hour and a half. Two hours is better.
(5) Drain the used flushing oil into suitable container properly marked for further use. Make sure drainage is complete.
(6) Refill reservoir with the grade of oil recommended by the manufacturer of the equipment. Run machine ten minutes and check oil level. NOTE: If the grade of oil is other than specified, filters should be cleaned and the above flushing and refilling repeated after 200 hours of service.

Adapted from THE HOUGHTON LINE (August 1948) published by E. F. Houghton & Co.

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ADVERTISERS' LITERATURE

(Continued from page 12)

A-15. MINNESOTA RUBBER & GASKET CO. A circular on rubber injection molding describing "O" rings and other rubber products is being distributed.

A-16. MODERNAIR CORPORATION. The CV valve series for air, water and low pressure oil is portrayed in an available bulletin.

A-17. PESCO PRODUCTS DIVISION. Data will be supplied detailing the complete story of Pesco Pressurized Power.

A-18. PRECISION RUBBER PRODUCTS. A handbook of "O" ring hydraulic packing presents engineering and application data.

A-19. RACINE TOOL & MACHINE. A complete three color catalog, P-10-D, describing the Racine line, can be had.

A-20. ROSS OPERATING VALVE COMPANY. Complete details of the Ross In-Line Master valve are contained in Bulletin 302.

A-21. ROYLYN, INCORPORATED. An illustrated catalog describes the line of hose couplings which are available in a pressure range of 650 to 6600 psi.

A-22. SKINNER PURIFIERS DIVISION. Engineering service to answer filtration problems is offered.

A-23. STANDARD PRESSED STEEL CO. Full details are supplied in Bulletin 675 for the complete range of pressure plugs.

A-24. VALVAIR CORPORATION. Bulletin A-H describing the variety of interchangeable control assemblies for a standard valve body is offered.

A-25. WESTINGHOUSE AIR BRAKE CO. Pneumatic control equipment is described in Bulletin IDA 9481-1. Information on the "Y" compressor is supplied in Bulletin IDC 9302-3.

A-26. YARNALL-WARING CO. Single pressure and two pressure valves are described in Bulletin H 216.

A-27. YOUNG RADIATOR COMPANY. Booklets presenting facts about fixed and removable tube bundle heat exchangers are offered.

A-28. FLUID CONTROLS INC. Catalog Sheets present operating characteristics, detailed dimensional data and capacity ratings at given pressures for pilot type relief valves.

A-29. KENYON INSTRUMENT CO., INC. A complete engineering data folder illustrates the 3000 psi shuttle valve designed to permit side loads on the shuttle to transmit directly to the body, leaving the pistons free to align themselves.

A-30. CHICAGO RAWHIDE MANUFACTURING COMPANY Sirvis mechanical leather packings are described in a general catalog available from this company.

A-31. GALLEND-HENNING MFG. CO. Bulletins detail the complete line of valve and cylinders for hydraulic and pneumatic service.

New PRODUCTS

For additional information on any of these products, mark the end key numbers on the card bound in this issue and mail the card.

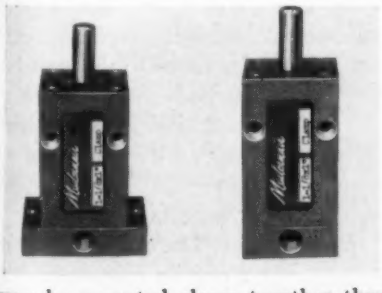
Air Regulator Filter-Lubricator

Engineering developments recently incorporated in the "R-F-L" unit, designed and manufactured by the Logansport Machine Company, have resulted in increased efficiency of this air regulator-filter-lubricator. The unit

incorporates a piston-type instead of bellows-type regulator, and the former porous metal air filtering element has been replaced with a synthetic type filtering element. Instead of being attached by means of small screws the filter cover and regulating valve now screw into the main body of the unit. The unit is a compact casting measuring 6 in square by 4¾ in deep. It includes a piston-type reducing valve, pressure gauge, lubricator and synthetic type air filter element. It is installed in the air intake line and can be mounted on a central control panel. *1.*

Air Clamp Cylinder

A new air clamp cylinder of completely square body design, currently available in three bore sizes: 1½, 2 and 3 in, has just been introduced by Modernair Corporation. This new square design facilitates mounting so that units



may be mounted closer together than with conventional clamps. Made from aluminum extruded stock, body and end caps have high tensile strength. Standard Allen screws, used to secure end caps, permit locating caps with inlet port convenient to piping connections. Long guide bushing with tolerance closely held with piston rod diameter, insures long service life. Standard models are furnished with one inch stroke, single acting spring return. *2.*

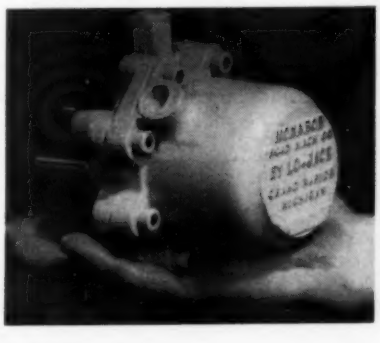
Pressure Actuated Switch

New Model "VISCO-TROL" switch manufactured by the Meletron Corporation is designed to be operated by heavy liquids and powders in explosive atmospheres. It may be adjusted to actuate a SPDT switching element at any predetermined pressure. Six classes of switches provide adjustable ranges from 2 in of water to 100 psi, with Proof Pressures up to 120 psi. The switch incorporates an Underwriter's Laboratory approved Explosion-Proof Micro Switch listed for hazardous location Class I, Group C and D, Class II, Group

6. Dimensions are 3 in diameter housing and 6 in overall. Pressure connection is through a 2 in internal pipe thread; electrical connection is through ½ inch conduit connector. *3.*

Hydraulic Pump

The HY-LO-JACK, a helical gear, pressure pump with built-in relief valve



and strainer has been developed by the Monarch Road Machinery Company. Designed for applications requiring 1000 psi and one gpm, the pump operates on less than one horsepower and weighs only seven pounds. One basic model is offered in four types which provide a variety of mounting and application. The basic unit may be had for flange mounting, foot mounting and combined with a three way valve and reservoir. *4.*

Automatic Timer

The new Eagle "CYCL-FLEX" timer is designed with auxiliary contacts operated by the clutch solenoid. These contacts, together with those operated after the time delay, provide four different load circuit combinations eliminating relays in many applications. Either a

momentary or maintained contact pilot switch can be used to start the timer. The timer mounts in a 3 3/16 in dia hole for flush mounting in control panels. It is rated at 10 amperes 110 v and is available for 60, 50 and 25 cycle frequencies of 110 and 220 volts. Time scales are available from 0-30 seconds to 0-10 hours. *5.*

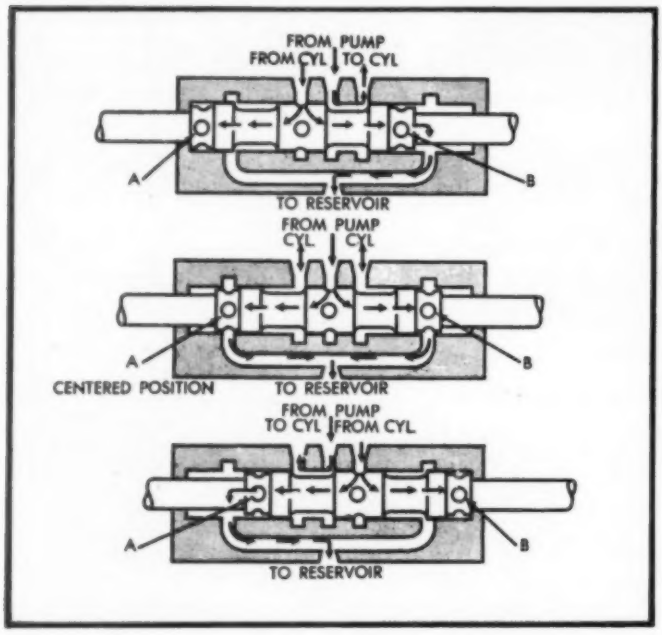
Scavenging Pump

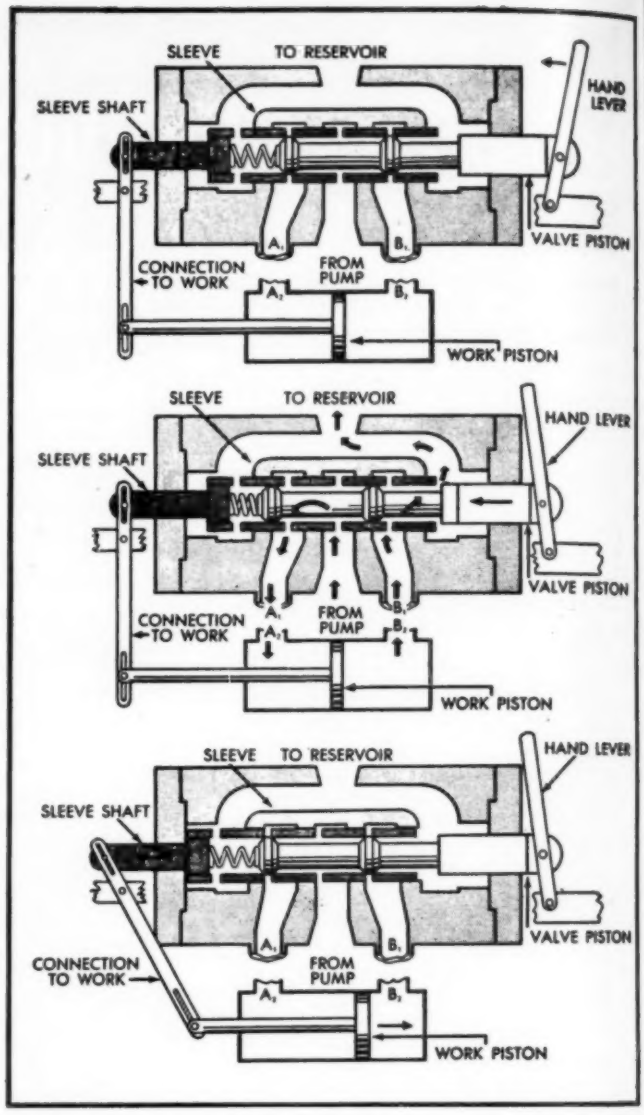
A five-element, gear type, scavenging pump for aircraft use has been brought out by the Great Lakes Mfg. Corp. The pump consists of four 3 gpm elements

and one 5 gpm element; each element has a separate suction port and a common discharge port. The pump develops 80 percent of its rated capacity with a 4 in mercury absolute inlet pressure and a 200 psi discharge pressure. The new pump which weighs only 3.7 pounds, operates at a continuous speed of 3860 rpm. *6.*

(Continued on page 40)

Fig. 95. Variation of open center spool valve with passages to work cylinder blocked when valve is centered. Liquid is carried to both ends of the piston to keep it balanced. With the valve centered, liquid may be discharged to other valves to perform a sequence of operations.





Figs. 96, 97 and 98. Operation of a follower or servo valve. Fig. 96 shows the valve in neutral position; in Fig. 97 the valve piston is moved somewhat left by the hand lever, liquid through A_1 enters left end cylinder and passage B_2–B_1 is opened to reservoir; in Fig. 98 the sleeve shaft of the follow valve has shifted left so that sleeve and piston are again at neutral.

(Continued from page 32)

Spool valves may be spring centered or spring offset, according to the position in which the piston of the valve stands when it is in neutral. A spring may return a spool to the center position whenever the force controlling it is released; or the spool may be returned to an off-center position when released.

A fairly common variation of this type of valve, the open center, cylinder ports blocked valve (Figure 95) is often used to operate a cylinder so that when the valve is centered, the cylinder ports will be blocked and the cylinder will be held in a definite position. Liquid from the valve pressure port will flow to the reservoir. Or the liquid from the pressure port may flow through the return or reservoir port to other valves and perform additional operations. These valves are useful in systems in which a sequence of operations are performed one operation at a time.

In addition to spring centered and spring offset operated spool valves, detents or latches may be employed. Detents are pins that are held against valve spools by springs. As the spool moves, the pin slides in or out of the spool grooves, locating and holding the spool in the grooved positions.

Spring offset valves are used on both manual and mechanically controlled machines. In manual operation, the spring will return the spool to its normal position when the operator releases the lever. In mechanical operation, a cam or dog pushes the spool inward and the spring returns the spool to its normal position when the holding mechanism releases it. The spring which returns the valve spool to its normal position is, in effect, a safety factor on hydraulically operated machines.

The latch type valve is used on circuits where it is not practical or possible to use a cam, a pilot controlled valve or where hazardous atmospheres do not permit the use of a solenoid controlled valve. This type of valve is useful in cycles in which the forward stroke on a machine is started manually, a dog or cam releasing the latch at the completion of the forward stroke, permitting the valve to retract or reverse the machine. A second cam or dog at the end of the reverse stroke moves the valve to neutral.

Common troubles with four-way valves include: binding of spools due to insufficient clearance between spool and valve body; sticking of mechanical linkage; scored spools; unbalanced condition due to excessive spool and body wear; coatings of varnishes and other oil impurities on spools; leaky oil seals; use of improper valves; broken springs; and improper installation.

Follow valve. The cylinder wall of a spool valve can be constructed as a movable sleeve and can be connected to a work operation in the manner shown in Figures 96, 97 and

98, so that motions of the valve piston precisely controls motions at the point of work. Figure 96 shows the follow or servo valve in neutral.

Flow through the valve to either side of the work piston is blocked since the piston heads of the valve close passages A_1 and B_1, which lead to the left and right entrances A_2 and B_2, respectively, of the work cylinder. A certain small amount of liquid is discharged by the pump through the valve when it stands in in neutral position. This will prevent the entire pump volume from being discharged through the relief valve. The follow valve can be designed to give a desired back pressure on each cylinder port by grinding the correct size of openings between the sleeve and plunger. The openings would admit only the amount of liquid necessary to maintain the desired back pressure.

If the valve piston is moved somewhat to the left by a similar movement of the hand lever (Figure 97), the pump will send liquid through A_1 to the left side of the work piston, at the same time the valve will open up a passage from B_2 on the other side of the work piston, through B_1 and on to the reservoir. This will cause a related movement at the point of work, which in turn will shift the sleeve shaft of the follow valve to the left until the sleeve and piston once more stand at neutral (Figure 98) but somewhat farther to the left than they stood in Figure 96.

The next installment will discuss rotary directional (pilot) valves. Be sure to save all installments for future reference. Copies of back issues containing previous installments are not available.

T.E.M.A. Elects New Officers

C. H. Currier was elected president, and W. C. Beekley, vice president, at the annual meeting of Tubular Exchanger Manufacturers Association, Inc., held recently at Skytop, Pa. George P. Byrne, jr., remains secretary-treasurer.

Mr. Currier is president of Ross Heater & Mfg. Co., Inc. Mr. Beekley is president of Whitlock Mfg. Co.

The following comprise the new executive committee: T. H. Miley, Foster Wheeler Corporation; G. A. Worn, The Lummus Co.; Mr. Currier and Mr. Beekley.

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Personalizes a Kup's capacity

Regardless of service, Palmetto Kup is always a "special"—ready to be tailored to the performance you specify.

No one packing can be all things to all service conditions. Temperature, pressure, motion, speed, the fluid handled—a variation in any one of these factors at once produces a new situation with which a packing must contend. Accordingly, Palmetto Packing Specialists have avoided "off-the-shelf" answers in filling even standard cup packing needs.

Whatever the service, each Palmetto Kup is built with a "personalized capacity" achieved through use of the one suitable fabric and one proper packing compound that match your application.

THE KUP THAT WON'T CRACK— AND NEVER RUNS DRY!

Fig. 1

Fig. 2

Though the service condition (see above) may suggest other structure, Palmetto Kup ordinarily is constructed as a sandwich. A disc of the prescribed synthetic rubber compound (see Fig. 1) is placed between discs of fabric which have been impregnated with the special compound. When pressure and heat are applied in molding, a complete bonding action takes place, producing a resilient, strong, uniformly reinforced product (see Fig. 2).

Kup will not "dry out" under stress of heat—or from non-use during shutdown periods . . . an important factor in air cylinder design.

Palmetto Kups are stronger at the heel because Kup fabric, cut on the bias, takes shape snugly, does not distort, so retains full strength—eliminates most common cause of failure.

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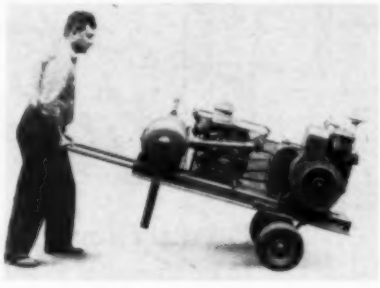
Ledeen cylinders are good cylinders!

Ledeen Mfg. Co.
1600 S. San Pedro St.
Los Angeles 15, Calif.

(Continued from page 38)

Portable Air Compressor

Two new Blue Brute Portable air compressors are being introduced by Worthington Pump and Machinery Corporation. Hand truck and trailer models are featured. These two-stage, air cooled compressors with 30 cu ft capacity at 100 pounds pressure, have a maximum operating pressure of 150 pounds. Powered by a hand-cranked,



air-cooled gasoline engine, the compressors have Worthington's patented feather valve, suction valve unloading, and a general design readily accessible for easy maintenance. They are equipped with oil bath cleaners and standard air receivers. *8.*

Revolving Joint

A new cartridge type revolving joint that requires no bearings, lubrication or flexible hose has been put on the market by Rotherm Engineering Co., Inc. This joint provides a simple, effective seal for air, steam, oil, gas, water and other fluids. The joint operates on the pressure seal principle—the higher the pressure, the tighter the seal. Two permanently fixed ball seats are employed; one screwed into a solidly braced piping connection and the other into the roll. The cartridge incorporates a carbon seal at each end to fit each ball. Thus it rides freely, assuming any position between the two ball seats. *9.*

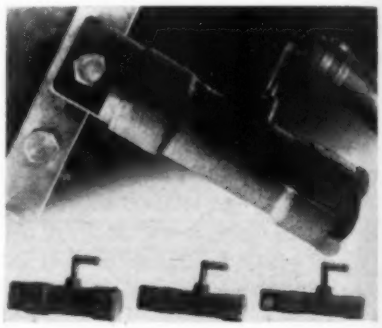
Splash-Proof Switch

To meet military and commercial requirements for protection against moisture, dust and splashing oil and water, a neoprene "boot" and neoprene side gaskets effectively seal the metal case of the new Unimax Type KMXB snap-acting precision switch. The "boot" is sealed to the actuating plunger and the

entire assembly is integral with the metal case. The neoprene seal retains its flexibility at all temperatures from –65 F to 160 F. The basic switch mounts inside the Adapta-case by slipping onto two positioning studs permanently attached to one of the removable side plates. *10.*

Pneumatic Vibrator

SPO Incorporated has announced the availability of a new Series 76 pneumatically-operated vibrators which have been designed for a wide range of industrial applications. Available from stock in eight sizes, these vibrators feature full-power start and minimum air



consumption, and a special bronze alloy cylinder liner which assures positive and permanent piston lubrication. Operating on standard 80 psi air line pressure, Series 76 vibrators deliver from 2200 to 6000 impacts per minute, depending upon piston diameter. Speed of vibration can be regulated by varying

THE MARKET PLACE

CLASSIFIED ADVERTISING

Rates: For "Positions Wanted" $4.00 minimum, limit 25 words. For all other classifications $4.50 minimum for 25 words, each additional word 15c; bold face type or all capitals, $7.50 minimum for 25 words, each additional word 20c; limit 50 words. Box addresses count as five words. All insertions are payable in advance.

These columns are limited to Help Wanted or Position Wanted ads, and offerings of used equipment by the users of such equipment.

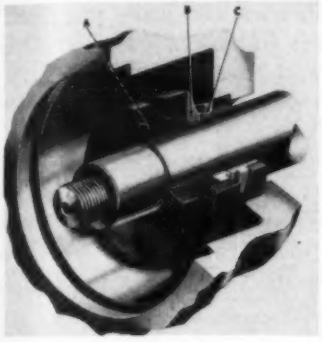
Wanted: Sales Engineer or small, active Hydraulic Equipment Selling Organization to handle Nationally known line of "O" Ring Seals—Territory New York State except metropolitan New York City—Headquarters preferably Syracuse or Utica. Please send complete details to Box 7150 APPLIED HYDRAULICS.

line pressure. Air consumption ranges from 4½ to 8 cfm. *11.*

CIRCLE NUMBERS ON THE CARD AND MAIL!

Mechanical Seal

A new mechanical shaft seal assembly has, as one of its components, a rotating seal collar made from Hycar nitrile rubber, a product of B. F. Goodrich Chemical Company. An application of the seal is shown on a Marlow pump. The "SF" shaft seal is furnished in either self-lubricating or grease lubricated models. The former is used with clear liquids and the latter with fluids which contain abrasive solids. Both assemblies have the same principal elements; stationary



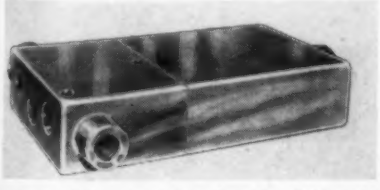
seal ring (carbon), stationary seal ring gaskets (Hycar) rotating seal ring (Meehanite), and rubber seal collar (Hycar). The principle of the shaft seal is to prevent leakage of liquid or entrance of air where the rotating pump shaft enters the stationary pump housing. *12.*

Pulsation Damper

Kellogg Products Co. has brought out a pulsation damper for protecting pressure gauges. The damper, made to fit ¼ in I.P.S. gauges, is designed for air, steam, water or gases for pressures up to 1500 psi. The damping mechanism is a piston which rises and falls within a coupling type housing to absorb shock and remove particles of dirt from the line. The damper is available in brass or stainless steel. *13.*

Pneumatic Valve

Quick action, light weight and simplicity of design are features of a new line of custom-built, solenoid controlled, pneumatic 3- and 4- way valves now being offered by Rhodes Lewis Company. Both the 3-way and 4-way valves



are available in ¼, ⅜ and ½ in tube sizes. Weight of 3-way valve is less than 1 lb in all sizes; weight of the 4-way ranges from 1.5 to 2 lb. Current and operating voltage is 18-28 v d.c. 1 amp continuous duty. Operating pressures from 200 to 1500 psi. *14.*

GREER ACCUMULATOR
Eliminates 9 hrs. Machining Time
Saves $90 in Cost and 20% in Floor Space of Brosius Manipulator

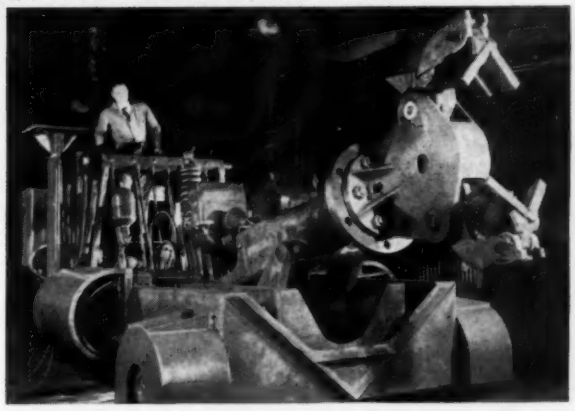


Photo Courtesy of:
Edgar E. Brosius Co., Inc.
Pittsburgh 15, Pa.

The huge Manipulator shown here weighs 31,000 lbs. and handles steel billets or blanks up to 12,000 lbs. Yet it moves about with amazing agility. It draws or charges, tilts up or down, raises or lowers, rotates and moves from side to side with the ease of a light-weight and will bring to your forge shop added speed, safety and economy.

Mr. S. T. Morgan, Chief Engineer of the Brosius Company reports that by incorporating a Greer Accumulator in its design a saving of 9 hrs. of machining time, 1 hr. of assembly time, and a 20% of floor space was easily obtained. And in addition, the cost of the manipulator was cut $90.

This is but one of numerous applications where Greer Accumulators are reducing cost, improving efficiency and enhancing safety and economy of systems and machines using hydraulics for power transmission.

Our bulletin 300 describes in detail the construction and uses of Greer Accumulators. Write for your copy on your company letterhead today.

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United States Patents Under Olear Licenses

GREER
HYDRAULICS INC.
454 EIGHTEENTH ST., BROOKLYN 15, N.Y.

YOUR SYMBOL OF SERVICE

(Continued from page 17)

tion and 171 for the light. In other words, about five times the horsepower can be transmitted for an equivalent pressure drop with the lighter oil.

As another comparison on the basis of energy transmission at an equal pressure drop per foot, it can be shown that a 9/16 ID tube at 6000 psi with the light oil can transmit the same amount of horsepower as a one inch ID tube under the preceding heavy oil condition. An electrical analogy is the common use of high voltage for efficient transmission of energy.

At 6000 psi, valves must be made to high quality standards but are specified in smaller sizes for a equivalent energy transmission rate. This size reduction carries over into pump equipment and results in less floor space per unit of horsepower. Small lines also make practical the use of quality tube fittings instead of gasketed flanges, with a resulting facility and economy in piping.

The marketing of dependable 2500 psi pumps and valves was closely followed by the 2500 psi press as force requirements were increased and more efficient sizes were necessary. As dependable high pressure equipment becomes available and process force requirements still mount, it may be expected that press designers will take advantage of higher pressures in the search for a more efficient machine.

Acknowledgments:

Figures 1 and 2 are published through the courtesy of Towler Brothers (Patents) Limited; Figure 3, through the courtesy of the John Robertson Company.

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ORIGINATOR OF **MICRONIC** FILTRATION

Results Prove It

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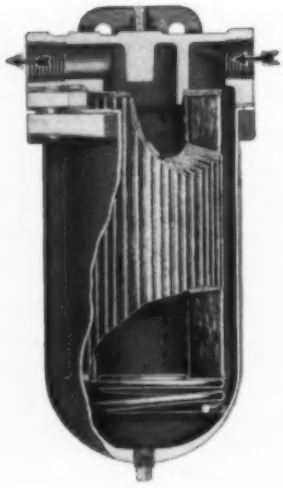
Name in Filtering

Nine times out of ten ***Bendix-Skinner*** Filters will supply the "finest" answer to your filtration problems. Here are the facts: available with patented, exclusive, resin impregnated cellulose elements; simple, quick replacement; high flow rate with minimum pressure loss; no channeling or bypassing; over 350 models providing filtration from ½ micron (.000019") upwards at flow rates from 1 to 5000 g.p.m. Why not let ***Bendix-Skinner*** filtration engineers work with you? Write us direct.



Model 3110-P filter element, 6⅛" x 3½", has a filtering area of 940 sq. in.!

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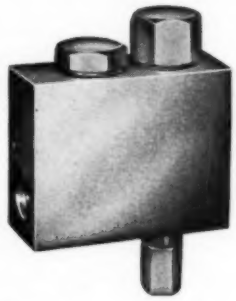
RELIEF VALVES



¼" and ⅜" Pipe Sizes

- ***Silent***
- ***Constant Pressure***

Adjustable — 50 to 1,000 P.S.I.
or 500 to 4,000 P.S.I.

- ***Economical***

Resale Price $12.50
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Useful Literature

The publications listed are available without charge. Mark the initial key number on the card bound in this issue and mail.

25. Tube and Pipe Fittings . . . The Weatherhead Company illustrates seven types of fittings and describes their characteristics in Catalog F-1456. The steel flared fittings and the Ermeto flareless fitting meet JIC standards. The catalog presents dimensional data and drawings for a wide range of fittings. Descriptions of service tools and shut off and drain valves are given.

26. Air Control Valves . . . A new catalog No. 100, Section 4 has been brought out by Logansport Machine Co. This 43 page catalog contains revisions on dimensions and functions along with completely new data on Logan's new air control valves. Sixteen diagrams illustrate typical applications of air valves and will be of value to the designer and user of air equipment in making the proper selection of control devices.

27. Hydraulic Fluid . . . A flame resistant industrial hydraulic fluid, also said to have high lubricity, has been developed by Monsanto Chemical Company. The fluid designated as OS-16 described in Bulletin O-D 601, has been field-tested in hydraulically operated mining equipment. In the tests, a coal-cutting machine was operated on a 24 hour, three day week in underground mining service. Hydraulic pressure was 1500 psi. A complete examination at the conclusion of the test showed no signs of wear in the hydraulic system, pumps or other moving parts in contact with OS-16.

28. Molded Seals . . . The 11th Edition of the Linear Moulded Seal Handbook of Design and Installation Data has just been issued. This edition, which has been expanded to 60 pages, contains tables of the latest AN and JIC packing standards. Complete design and installation data is presented for "O" rings, "V" rings, "U" packings and piston cups. Drawings are widely used to illustrate a variety of packing applications. Data for machining fittings for use with seals is included. A section of reference material provides data on surface finish and calculations of springs for non-adjustable glands using "V" rings.

29. Lubrication . . . "Eleven ways to cut production costs" are graphically portrayed in a pocket-sized primer on industrial lubrication published by the Alemite Division of Stewart-Warner Corporation. Eleven examples of production or machinery expense economies, attained through modern handling and application of greases and oils, are presented in the booklet, with advantages over methods they are designed to improve, given in terms of lubricant savings, increased production use of machinery and elimination of labor costs or machine repair costs.

30. Micro-Air Cylinders . . . A catalog sheet issued by Air-Mite Inc., illustrates their micro model cylinders. These bantam cylinders, designed for limited space will transmit 75 per cent of the inlet pressure. A vertical model having an overall length of 3⅜ in and a parallel model, 4 in overall length are available. The units may be controlled singly or in series connected and parallel connected groups.

31. Strainers . . . Bulletin S-203 provides up-to-date data on Yarnall-Waring Company's screwed ¼ to 3 in strainers and expanded details on Yarway flanged strainers, ½ to 5 in. Monel woven wire screens are suitable for handling light oil, air and other fluids. The strainers are available in 10 sizes

* Fluid Power Improves Production

"LOGAN" AIR CYLINDERS

STANDARD AND HEAVY-DUTY MILL-TYPE

LOGAN FEATURES THAT ASSURE PEAK PERFORMANCE AND LONG LIFE . . .

- Larger ports for quicker response.
- More sturdy construction.
- Standard models available with or without cushioning.

Fast-Acting, Positive Controlled Power . . . At Low Cost

7 STANDARD MOUNTING TYPES

Standard sizes from 1½" to 12" bore; maximum stroke, 18 feet.

Special to meet your requirements.

* ENGINEERING COUNSEL

Consult our engineers.
No obligation.

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Get your free copy of catalog containing complete information on Logan air cylinders, control valves and air accessories.

LOGAN STANDARD AIR CYLINDERS

Replace most manual operations . . . eliminate human error.

LOGAN HEAVY-DUTY MILL-TYPE AIR CYLINDERS

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VALVES • CYLINDERS • VALVES • PRESSES • SURE-FLOW COOLANT PUMPS

FLUID POWER SPECIALISTS SINCE 1916

with bronze or cadmium plated iron or steel bodies. Diagrams suggest installation locations for the strainers.

32. Solenoid Valves . . . Skinner Electric Valve Division describes their 2-way normally open, 2-way normally closed and 3-way, 2 position solenoid valves in Bulletin 501. These valves which will handle oil or air, are of stainless steel construction and provide operating pressures from 10 to 250 psi. A cross-section shows the spring loaded construction which uses soft synthetic inserts on stainless steel seats, an impregnated coil to resist moisture and welded joints for a positive assembly.

33. Industrial Controls . . . Motor operated valves are described in Barber-Colman Company's catalog along with control applications and control motors. The valves, made for the control of oil, air and other fluids, are available in models which provides three types of motor control. Two position controls provide full on or full off operation. Floating controls move the valve until the system is in balance at the controlling instrument. Proportional controls move the valve to a position proportional to the amount of change in the controlling instrument. Charts and tables are presented for the selection of valves and controls.

34. Air Line Filters . . . A four page Bulletin illustrates the Cuno Engineering Corporation's Micro-Klean air line filters which are designed to remove moisture, dirt, pipe scale and foreign particles down to one micron in size. Four models are illustrated showing a range of capacities from 15 cfm to 480 cfm and a range of pipe connections. The units, designed for a maximum operating pressure of 125 psi are applied to a variety of equipment.

CIRCLE NUMBERS ON THE CARD AND MAIL!

35. Coolant and Lubricant Pumps . . . A Pump Engineering Manual has been prepared by the Pioneer Pump & Manufacturing Company for their line of impeller type JIC Standard coolant and lubricant pumps. These pumps are built in a wide range of capacities up to 174 gpm. Capacity charts show the gpm and pressures each pump size will deliver at various feet of head and the horsepower for various speeds.

36. Hose Assemblies . . . Sleeve type, sleeveless type and clamp type hose assemblies are described in Anchor Coupling Co. Catalog 49-S. Bend radii are tabulated; working pressures range to 6000 psi. Unions, pipe fittings and reusable couplings are shown along with methods for computing length of hose assemblies. A nomograph offers quick determination of flow capacity at recommended velocities.

37. Air Pumps . . . Designed for applications where vacuums up to 29 in and pressures up to 25 psi are required, Leiman Bros., Inc. air motors are described in Catalog 450. Pumps are available in four and two wing types. The wings or hinged blades scoop the air through the pump. Characteristic curves and installation data are included.

38. Carbon Bearings and Seals . . . Purebon, a product of Pure Carbon Company Inc., is discussed in 24 page Bulletin 482. Purebon is self lubricating and non-corrosive, properties include close molding tolerances and good machinability. Applications include bearings, seal rings, thrust washers, pistons, piston rings, impeller blades and places where lubrication between two rubbing parts is difficult. A variety of seals are illustrated and engineering data is offered.

39. Relief Valves . . . Data Sheets offered by The Fulflo Specialties Co. provide dimensional and application material for their line of by-pass piston type oil relief valves. Graphs show flow characteristics for the valves which range in port sizes from ⅜ to 2 in. The illustrated valves offer a wide range of pressure applications.

40. Airflex Couplings . . . The Falk Corporation's engineering Bulletin 8105 presents construction features and

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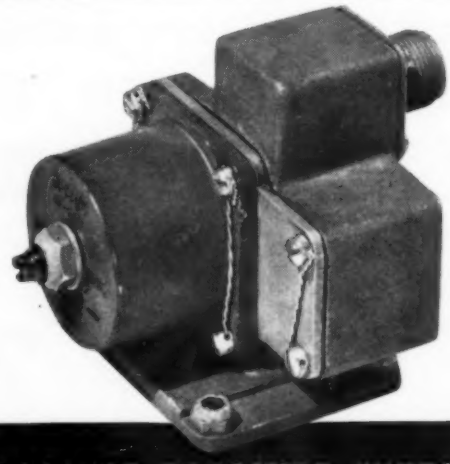

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- Conforms to Spec. MIL-S-5723
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- For air pressurization

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methods of selection for their airflex couplings. Thrust type and floating shaft type couplings are illustrated. To assist in the proper selection, tables provide service factors for many applications including pumps and compressors. Step by step examples of selections and dimensioned layouts are included.

41. Tube Bending . . . Celebrating their 50th Anniversary, the Wallace Supplies Mfg. Co. have issued a 58 page booklet, "So You Want to Use Tubing". Practical considerations for bending tubing are presented along with tables of data. The complete line of Wallace Bending and Rolling machines is described. Special examples of bending are illustrated.

42. Rotary Pumps . . . Two basic vane type pumps, sliding vane and swinging vane, are described in Blackmer pump Bulletin 307. The design permits the vanes to move farther out of the rotor recesses as wear occurs. For applications handling corrosive of mildly abrasive liquids a replaceable liner is suggested. Action of the swinging vane type, which is recommended for liquids containing solids and non-viscous liquids, is shown diagrammatically. A vane selection chart lists the applications of the two types of pumps.

43. Swivel Coupling Catalog . . . New catalog No. 50 issued by Gil-Lair Products, Inc., describes the design features, gives specifications, working pressures and prices of its complete line of high and low pressure All-Flex ball bearing swivel pipe couplings. There are 8 basic styles in sizes from ⅜ to 12 in and for pressures from vacuum to 12,000 psi. Associated products of the company are also described.

44. Disc Type Air Filter . . . Four page Bulletin 631, issued by Skinner Purifiers Division, Bendix Aviation Corporation, describes the Model A-1, cleanable, disc type air filter. Air passes between the stack of phenolic resin-impregnated cellulose discs. The discs are held together by spring tension to form a tube. Cleaning and installation instructions are provided. Fifteen cfm is the recommended maximum air flow for efficient removal of moisture and solids, 10 microns and larger.

CIRCLE NUMBERS ON THE CARD AND MAIL!

45. Pipe Plugs . . . U. S. Plug & Fitting Co. has issued an application sheet on "Breather Vent" pipe plugs. A sintered bronze core permits the breathing action. The plugs feature the "Dryseal" pipe thread and are available in a variety of head styles and materials. A range of pipe sizes from ⅛ to 4 in is provided.

46. Globe and angle stop valves . . . A new bulletin describing in detail the new Edward Fig. 444 series globe and angle stop valves has just been issued by Edward Valves, Inc. Bulletin 501 gives design details, dimensional data, material specifications and list prices for the new forged steel valve series which is built in both 600 and 1500 lb sp classes.

Main-Ten-Ends

REDUCE PRODUCTION COSTS

IN A PAPER, "THE MAIN-TEN-Ends in Hydraulic Maintenance", presented by M A. Hayden at the Fifth National Meeting ASLE in April at Detroit, a plan based on a combination of the best hydraulic maintenance practices was outlined. Mr. Hayden very aptly highlighted the aims or ends of such a maintenance program in ten points or "main-ten-ends". The first of these points is below. Other "ends" will be published in succeeding issues.

End 1. **Recognize that the user has more control over maintenance than either the machinery builder or hydraulic equipment manufacturer.**

Once it has been demonstrated that a new machine performs as required the user must take steps to maintain that satisfactory performance. The user is responsible for:

1. Accurately specifying what he wants in a hydraulic machine,
2. Using a good hydraulic oil,
3. Operating the hydraulic system within its limitations,
4. Using qualified people to systematically maintain the equipment.

Users of hydraulic equipment will take the first step toward controlling their maintenance problems by using JIC recommendations when making up specifications. The recommendations stress safety, accessibility, reasonable oil temperature, the separation of the power unit from the machine, and the use of gasket mounted valves with subplates which permit permanent piping and make possible control cabinets for hydraulic equipment.

PLENTY of POWER

IN THESE HYDRAULIC PUMPS and FLUID MOTORS

There's plenty of power in Eastern fluid motors and hydraulic pumps. They're tough and compact—ideal where space is at a premium. They're dependable, too. Long life under rugged operating conditions is built-in. An Eastern hydraulic pump or fluid motor in your design is good engineering.

SERIES 100

.1 to 5 GPM—Drive speeds up to 3450 RPM. Working pressures up to 1000 PSI. Average volumetric efficiency: 90%. Average model weight: 1.65 lbs.

Lightweight construction is obtained through use of aluminum housings and nitralloy gears and shafts. Each unit is factory pre-tested for precision and operating efficiency.

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Eastern INDUSTRIES, INC.

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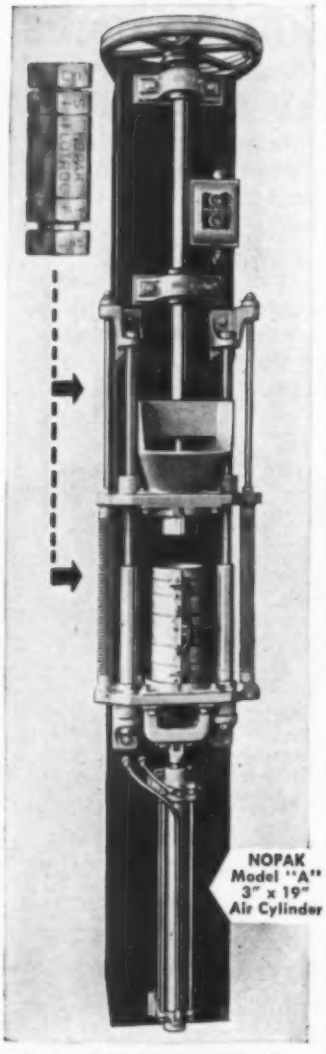
ACE
Drain-Tile Machine *Employs*
NOPAK Cylinder and Valves!



Arrows indicate location of NOPAK FLO-TROL VALVES

Precision molding of concrete drain tile on an Ace Machine is a simple, efficient, low-cost operation. The Model "A" NOPAK Air Cylinder raises the casing to charging position . . . then retracts it at a *slow, controlled speed* while rotary polishing trowel puts a smooth, even finish on interior of the tile. The oversize cylinder is precision-mounted to provide ample power and positive vibrationless action.

Two NOPAK Flo-Trol Valves control cylinder stroke speed . . . in both directions, to insure uniformity of repetitive work-cycles.

This is typical of many work-feed, positioning and holding applications in which NOPAK Valves and Cylinders are used. Others are illustrated in the NOPAK Application Manual. Your NOPAK representative will gladly show them to you. If you don't know who he is, write —

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NOPAK

VALVES AND CYLINDERS

DESIGNED for AIR and HYDRAULIC SERVICE

A 5786-½A

APPLIED HYDRAULICS DIGEST

Abstracts, summaries and listings of articles on hydraulic and associated applications in industry; reports on prepared papers, talk and discussions pertinent to the hydraulics field.

Hydraulic Systems and Elements

Editors, *Product Engineering*, v 21, June 1950, pp 138.

Simplicity of installation can be designed into hydraulic systems. Flexibility of control, low maintenance costs, compact packaged units, linear or rotary motion are available to the designer. He should consider standardizing on components as much as possible. Unit elements should be selected on the basis of maximum load requirements. Valves of sufficient capacity will reduce maintenance costs, back pressure and overheating. Mounting valves near cylinders, using remote control will reduce piping problems. Grouping controls into a single package control panel and using gasketed elements to develop a unitized design is recommended.

Whenever possible use commercial tanks placed high

Hydraulics

that fit your problem

Every year sees greater use of hydraulics.

Each year passed has added to our own extensive store of hydraulic know-how.

Out of this experience we have accumulated a ready-made source of proven hydraulic designs. If you are incorporating hydraulics, call on Hufford for proven hydraulic systems. It's safer to know than experiment!

HUFFORD MACHINE WORKS, INC.

Redondo Beach, Calif.

Builders of the famous Hufford Hydraulic Stretch-Wrap Forming Machines, Hydraulic Ceramic Presses, Hydraulic Elevators, and Specialized Hydraulic Machinery.

HUFFORD HYDRAULICS

enough to facilitate draining and cleaning. Provide adequate tank capacity to maintain low velocity flow between return line and pump suction line, locate these lines far apart and separate with a baffle.

Matching Solenoid Characteristics to Load

Frank E. Reeves, *Electrical Manufacturing,* v 45, June 1950, pp 104-107, 188-194.

For the correct selection of solenoids the following basic information is required:

1. Type of motion required: pull, push, push-pull or rotary,
2. Force required,
3. Duty cycle and ambient temperature,
4. Length of stroke,
5. Voltage and frequency.

Four-way solenoid controlled valves use a push-pull type solenoid having two coils to provide power strokes in two directions with the same force being exerted in each direction.

Specification of force required in pounds only is not sufficient. Initial pull or push at a specific stroke and final or "holding" value are required; intermediate values must be known when the force is not directly proportional to the distance of the plunger end from the stop or seat.

Stock solenoids are usually classified by the manufacturer as "continuous" or "intermittent". The "continuous" term assumes that the unit will be de-energized very infrequently if at all. Regardless of the capacity of the solenoid, the length of plunger travel for best

BETTER BRONZE PARTS FOR ALL TYPES OF PUMPS

American Crucible methods, know-how, experience and equipment result in highest quality parts at attractive savings to you.

Thrust plates, bearing plates, pressure plates, bushings, seals and connecting rods, machined or rough cast from

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of the specific formula best suited to each application. That's why they carry a

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PROMET BRONZE BAR STOCK

Round, solid or tubular. Rough cast or fully machined. Cored stock all sizes (by 1/8" steps) from 1/2" minimum core to 26" O.D. and 13" lengths or less. Six grades of hardness.

Write for literature or let us make recommendations and quote you. Simply send blueprints, conditions of operation and other data.

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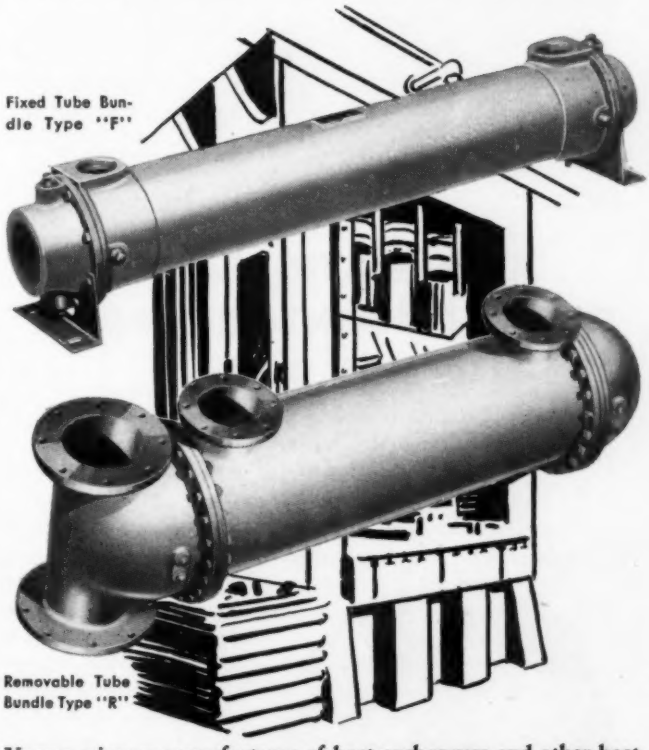
Now!

YOUNG Type "F"
HEAT EXCHANGERS
Available from Stock



Fixed Tube Bundle Type "F"

Removable Tube Bundle Type "R"

Young, pioneer manufacturer of heat exchangers and other heat transfer products, now offers greater savings in initial and maintenance costs with its newly designed heat exchanger line. Corrosion-resistant Admiralty tubing, larger tube sizes, and engineered tube spacing and baffling mean longer service, easier maintenance. Coupon brings full details, without obligation.

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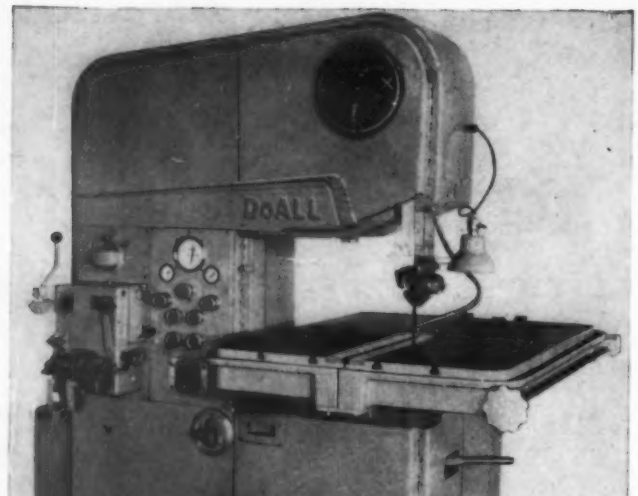
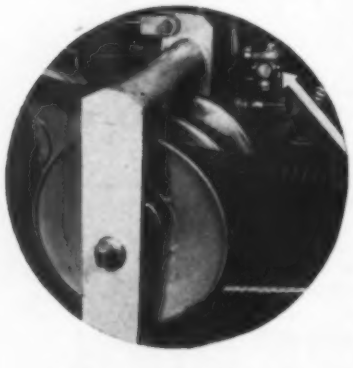


AUTOMATIC SAFETY FOR THE "CONTOUR-MATIC"

The DoALL Company, Des Plaines, Illinois has developed a most ingenious yet practical machine for contouring and shaping solids quickly and with elimination of chip waste.

Operational safety is provided in part by an ASCO 3-Way Solenoid Valve. It is used in the brake circuit and is open during machine operation allowing the oil to circulate. When the machine is turned off—or if a blade should break—the current to this solenoid valve is cut off which checks the flow of oil through the brake circuit, thus forcing the hydraulic oil into the brake cylinders which actuates the brakes and, in turn, stops the wheels.



So much in the way of automatic control—including remote control—with solenoid valves is being done that you should investigate them fully for controlling the flow of any gas or liquid in the machine you are designing. ASCO Engineers will be glad to recommend the proper type for your problem, as they have for hundreds of others. In writing, be as detailed as possible.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

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operating results is usually limited. A short pull draws less current if ac, adding the safety factor of fast, positive action.

Practical limitations to the use of ac solenoids are in the magnitudes of force and stroke required. When the stroke exceeds 2 in and the force needed is over 50 lb it is usually considered advisable to use dc units. Since the amount of work obtained from a solenoid is constant, it is just as important to select a unit which is not too large as it is to select one which is not too small.

Nine suggestions are presented for correct application of solenoids:

1. Avoid hammering and mushrooming of plunger,
2. Utilize plunger impact,
3. Work plunger near stop,
4. Plunger should seat at the end of work stroke,
5. Avoid excessive temperature rise,
6. Consider the use of levers,
7. Avoid friction and wear,
8. Protect solenoids from oil and water,
9. Protect electrical connections.

Solenoids can be used with the greatest effectiveness if the plunger is permitted to accumulate inertia before picking up the load. Impact force reaches a high value where the work stroke is short and at the end of the travel.

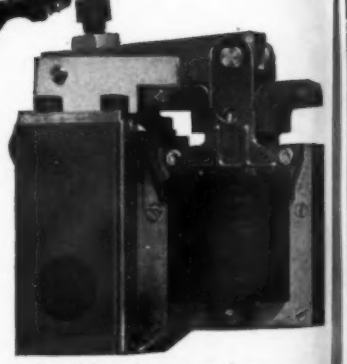
Send one or two proven ideas to Here's How Editor. We will pay $5.00 for each item used, $10.00 for the editor's best selection each month.

NEW HIGH PRESSURE
SOLENOID VALVES

Now available in 110—220—440 volt 60 cycle A. C. current

Features

- Rugged compact construction
- 3000 P.S.I. operating pressure
- Continuous duty
- Poppet design eliminates leakage
- May be mounted in any position
- Impregnated coils resist moisture and condensation



Waterman High Pressure Solenoid Valves are inexpensive, compact units designed for continuous duty in hydraulic systems where pressures are as high as 3000 P.S.I. Poppet type construction gives positive sealing against internal leakage. Impregnated oil resistant coils make these valves suitable for mounting in oil reservoirs. In many cases this feature eliminates costly piping and makes possible the construction of smaller, more compact hydraulic power units. Available in ⅜" pipe size. Electrical requirements are 110—220—440 volt—60 cycle A.C. current.

West Coast: H. E. Webb, 918 No. Kenilworth Ave., Glendale 2, Calif.

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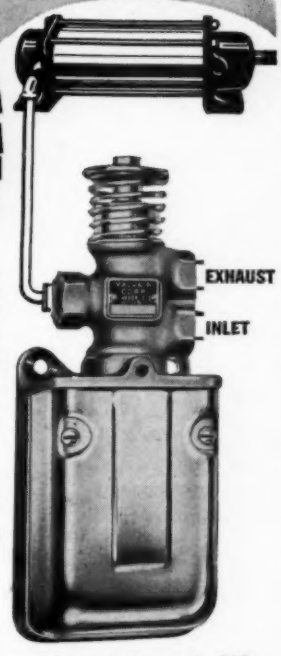
1721 CUSTER AVENUE • EVANSTON, ILLINOIS

This **VALVAIR** SOLENOID OPERATED

AIR CONTROL VALVE

is *Sensationally Dependable!*



. . . and its dependability is due to many quality features. *Examples*: the "O-U" packer, no metal seats, heavy solenoid and standard pipe area through valve, permitting unrestricted air flow and preventing pressure loss. Yet Valvairs cost no more.

For use with air, water or oil pressures up to 175 p. s. i.; temperatures up to 120° F. 2-way; piped exhaust — 3-way, 4-way. Also in knob, lever, cam, clevis, foot, treadle, cylinder, diaphragm types.

Sizes: ¼", ⅜", ½", ¾", 1".

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Ask for Bulletin "A-H".

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AFFILIATE: SINCLAIR-COLLINS VALVE CO.

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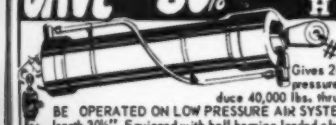
SAVE UP TO 85% in WAR SURPLUS HYDRAULICS



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Gives 20,000 lbs. thrust (push pull) using 1500 PSI line pressure as obtained from our hyd. pumps. Or will produce 40,000 lbs. thrust with 3,000 lbs. line pressure. CAN ALSO BE OPERATED ON LOW PRESSURE AIR SYSTEMS. 4" Bore, 1½" dia. piston shaft, 18" stroke, length 30½". Equipped with ball bearing loaded clevis type mounting and swivel type high pressure steel pipe bracket for easy use. Ideal for road farm and shop machinery, presses, etc. Cost Government $390.00 . . . . . NOW 22.50

HYDRAULIC CYLINDERS

NO. 3A – Bore 1½", Shaft ¾" Stroke 5", Length 10½" 5.75

NO. 9E – Bore 1-3/8", Shaft 1" Stroke 15-5/8", Length 15⅝" 8.50

NO. 3S – Bore 1½", Shaft 1" Stroke 26", Length 23½" 12.75

HYDRAULIC TRANSMISSION

Self contained, 2 H.P. constant torque at all speeds with variable volume reversible, piston pump (controlled by outside lever.) supplying piston hydraulic motor. Automatic pressure, Dash pot for smooth control. Power output R.P.M. – 0 to 1/3 input R.P.M. in both directions. Input R.P.M. 1800 continuous 4000 intermittent. Dash pot can be removed for greater R.P.M. Ideal for Lathes, Duplicator Setup on Mills, Conveyors, Small Cars, Drives, Gearing, etc. Includes 2 - 4" Spline Shafts for input and power take-off. Cost Government approx. $400.00 27.50

HAND PUMP

Provides an instantaneous source of tremendous power for almost any heavy work. Double action stroke. Delivers .30 cu.in. per cycle at 3000 PSI. Maximum pressure 5000 PSI. Has built-in reservoir with 2¼ qts. capacity. 3/8" pipe outlets and pressure release valve. Base is 7⅝" diameter. Pump is 23 3/16" overall height. Weight 15.2 lbs. A $40.00 Value 15.95

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HYDRAULIC PUMPS

ANGLE PUMP

Positive displacement type, angle piston. Displaces .507 cu.in. per revolution. Has capacity of 6 gal. per minute at 3000 RPM at 1500 PSI continuous 1875 for 15 seconds. Operating speed of 3750 RPM, intermittent maximum 4500 RPM. Rotates to the right only. . . . . NEW 14.49

HP-3V-HAND PUMP

HP-3V-HAND PUMP – Operating pressure 2000 PSI. Capacity, 1.5 cu.in. per complete cycle. Has added feature of a diverter valve for selecting a suction & pressure port for two independent systems. . . . . ONLY 12.75

P-3 STRATO POWER PUMP With built-in variable flow control valve in head. Positive displacement piston type. Displaces .450 cu. in. per revolution. Two gal. per minute capacity at 1500 RPM at 1250 PSI. Pressure limit, 1250 PSI continuous. 1400 PSI for 15 seconds. Operates at 3750 RPM, intermittent max-4500 RPM. Rotation either direction without adjustments. NEW 17.50

FOUR WAY VALVE

V-16 – Poppet Type. Off at neutral position. 3/8" AC Tube Ports – (9/16 - 20) thread. P.S.I. 1,500 . . . . . 4.75

V-17 – Poppet Type. Pressure balanced. Off at neutral position. Piston type with built-in relief valves for limit of cylinder strokes. ½" Standard pipe inlet & outlet ports. ½" AC tube to cylinder (½" - 18) thread tapped ports. NEW 6.75

GEROTOR TYPE PUMP

Logan Gerotor type. For operating hyd. systems on tractors, trucks industrial machinery, etc. Delivers 8 GPM, at 1200 RPM, at 1000 PSI with 5 HP. Can also be used as Hydraulic Fluid Motor. Has 3/8" stnd. pipe ports, ½" splined shaft for pulley or direct attachment. 5½" dia. x 7" lg. Used but guaranteed condition. Now ONLY 17.50

We carry the World's Largest Supply of New Hydraulic Equipment featuring over 20,000 Cylinders in 61 Sizes & Types. Can also supply all accessories such as Pumps, Fittings, Valves, Tanks, Hose Fittings. Let us solve your Hydraulic problems. Write for inform.

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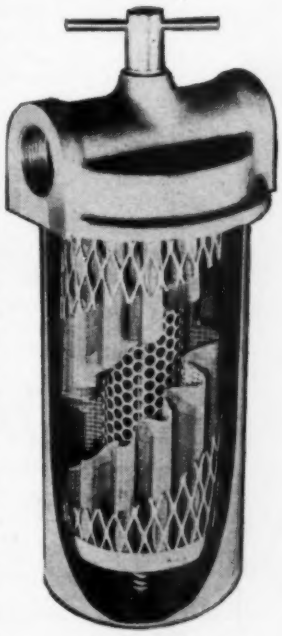
Their O.E.M. Choice

SUMP TYPE (Cutaway)

For HYDRAULIC EQUIPMENT where oil MUST BE CLEAN

These efficient, versatile filters adapt readily to all installation needs, give more filtering area in same space than like size circular units. Both sump and line types operate at full efficiency in any position and can be installed at the angle most convenient for your machine. Either type may be disassembled, cleaned and reassembled in minutes. Removing a single handnut releases the line model housing for quick cleaning without disturbing pipe fittings. Adaptable to your needs in every way, Marvel Synclinal Filters may be had with wire mesh sizes from coarse 30 to fine 200. Individual capacities are from 5 to 50 g.p.m., and greater capacities are obtainable by multiple installations.



LINE TYPE (Cutaway)

For efficient filtration of non-corrosive liquids in all HYDRAULIC or LOW PRESSURE circulating systems Marvel has your answer. Write for catalogs 104 and 202.

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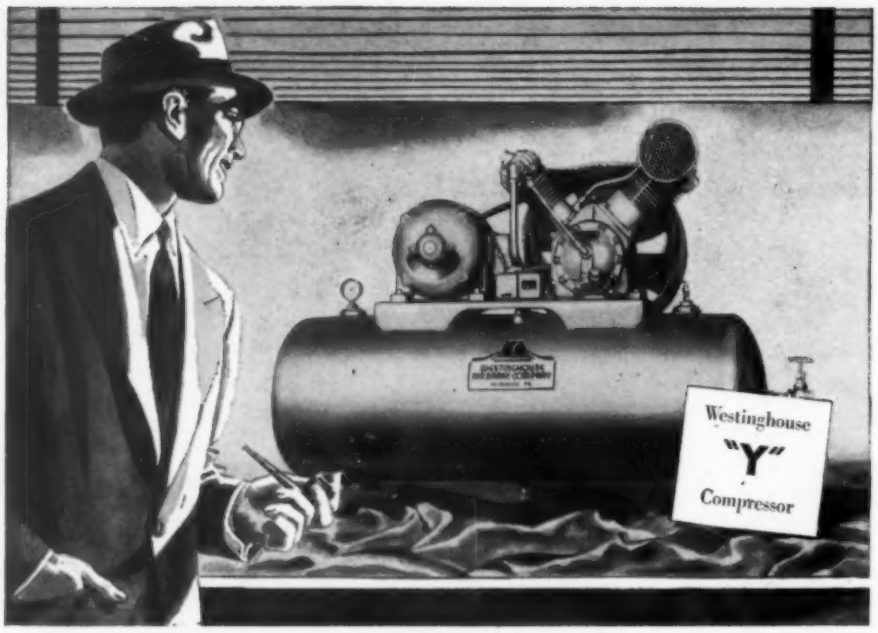

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Here's a Checklist you can follow!

☑ *the Westinghouse "Y" Compressor*

Cut costs, boost efficiency, eliminate complication—Departmentalize your air supply—install a Westinghouse "Y" in each work area. Operate only when required . . . eliminate cost and complexities of pipe network.

Westinghouse "Y's" give you the famous "Engin*aired*" features: 1) Controlled Pressure Lubrication; 2) Low Oil Level Protection; 3) Thermal Overload Protector. Write for Bulletin IDC 9302-3.

☑ **FLEXAIR® VALVES**

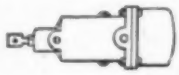
Give graduated control for clutches, cylinders, etc. Supplied in different styles for one to four pipe control.

☑ **H-Type CONTROLAIRS®**

Single and double Valve construction for graduated pressure control. Arranged for pedal, cam or knob operation.

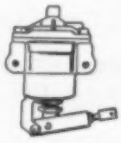
☑ **TRIDYNE®**

A three-position power cylinder.



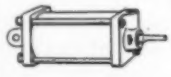
☑ **PILOTAIR® VALVE**

Single and double construction for flow control.



☑ **ACTUATORS**

Power transmitting devices used where precise positioning is required.



☑ **CYLINDERS**

Single or double acting, in 1" to 6" dia., with 2", 4", 6", 8" and 10" stroke.

Westinghouse Air Brake Company's pneumatic control equipment covers the field of industrial needs. All devices designed to withstand hard service, to group readily, mount accessibly. Write for Bulletin IDA 9481-1.

Westinghouse Air Brake Co.

Industrial Products Division—WILMERDING, PA.

DISTRIBUTORS THROUGHOUT THE UNITED STATES . . . CONSULT YOUR CLASSIFIED DIRECTORY

LETTERS TO THE EDITOR

(Continued from page 13)

A set of tear sheets of this article, which ran in two parts in the January and February, 1950 issues, has been sent to you.

We understand there is a hydraulic gear for cars and lorries now marketed in the United States; reports on this side indicate that it is being used as an alternate to orthodox gears by most large American car manufacturers. We would be glad to know if there is such a mechanism on the American market and the name or names of the firms who make them. Also, is this identical or different from the magnetic clutch?

W.P.
Derby, England

Most of the hydraulic clutches are of the torque converter type and most leading American automobile manufacturers and several leading truck makers design and are building their own hydraulic clutches or have them built by their suppliers. The names and addresses of several manufacturers who build this equipment for trucks and buses have been sent you. The magnetic clutch, while available, has been restricted largely to heavy industrial machines, although at least one company offers units for machine tool use. The names of several such manufacturers have also been forwarded to you.

We have found the short resumes of the conference papers of the Committee on Hydraulic and Pneumatic Systems in your March and April issues very interesting. Are the full texts of these papers available? Do you expect to publish the entire series?

G.H.R.

The resumes have been specially prepared in each case by the man who gave the original talk and, to the best of our knowledge, complete written copies do not exist because the discussion was informal. However, if you will indicate which subjects you are particularly interested in we will check for you.
We expect to run the entire series of six resumes and will publish them as regularly as space permits and as they are made available to us.

We have noted that several references to short or shop training courses in hydraulics have appeared in APPLIED HYDRAULICS. Are there outlines or subject matter bibliographies available? We are planning a shop course for our maintenance men this fall and would appreciate such information as you may be able to send us.

K.H.
B.F.

We have some of this information, especially an outline of one short course and a copy of the APPLIED HYDRAULICS *Data List, which is being sent to you. For our own records and to be of help to others, we would appreciate it if you would send us your outline when prepared.*

POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

Hannifin Corporation announces the transfer of **George O. Hendee,** for over four years Hannifin sales and service engineer in the Philadelphia area, to field service and sales engineer for New England, where **Elliott D. Thompson,** of Boston, has withdrawn as sales representative after more than twenty years with the firm. Mr. Hendee, who will make his headquarters at Worcester, began his career in the hydraulic and pneumatic field immediately following his graduation from Purdue University in 1934. Mr. Hendee is succeeded at Philadelphia by **Joseph O'Malley.**

Charles T. Morgan, 21 Lothrop Street, Beverly, Mass., has been appointed manufacturer's representative in eastern New England, by **Sperry Products, Inc.,** Danbury, Conn.

Selden T. Williams, vice president of Scovill Manufacturing Company, Incorporated, and general manager of A. Schrader's Son Division has been elected president of **A. Schrader's Son, Inc.** Mr. Williams joined A. Schrader's Son in 1929 and was appointed vice president of Scovill Manufacturing Company, Inc., in charge of manufacturing of Schrader Domestic and Foreign Plants in November 1944. Mr. Williams graduated from St. Lawrence University, B.S. in 1913 and earned his Master's degree there in 1926. He received his B.S. degree in Mechanical Engineering at Worcester Polytechnic Institute in 1916.

Bernard Dolan, formerly merchandising manager of **Peter A. Frasse & Co., Inc.,** New York, has been named manager of sales.

Clifford Wood has been appointed Eastern division manager for the **Catawissa Valve & Fittings Company.** Mr. Wood will have his headquarters in New York City.

Compressed Air Products, Maplewood, New Jersey, have been appointed distributors for **Acme Gauge and Instrument Co. Inc.**

The appointment of **Robert E. Ward** and **Ralph D. Ferguson** as manager and sales manager, respectively, of the nationally known foundry at the **Eclipse-Pioneer Division** of Bendix Aviation Corporation is announced by Raymond P. Lansing, general manager of the division.

The Cook Electric Company announces the appointment of **William H.Wells** as liaison engineer, stationed at Red Bank, New Jersey. He will represent the firm and its research division in the northeastern part of the United States.

"O" RINGS SINCE 1941

Outstanding by nature—Parco Balanced Compounds + precision moulding make the outstanding hydraulic packing. For "O" ring packing, investigate "O" rings from Parco Balanced Compounds. All dash numbers of both 6227 and 6230 series for commercial application or Army-Navy installations to Specification ANP 79 are available from stock.

Catalog and engineering data on request. Write us today.

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Parco

Plastic & Rubber Products Co.

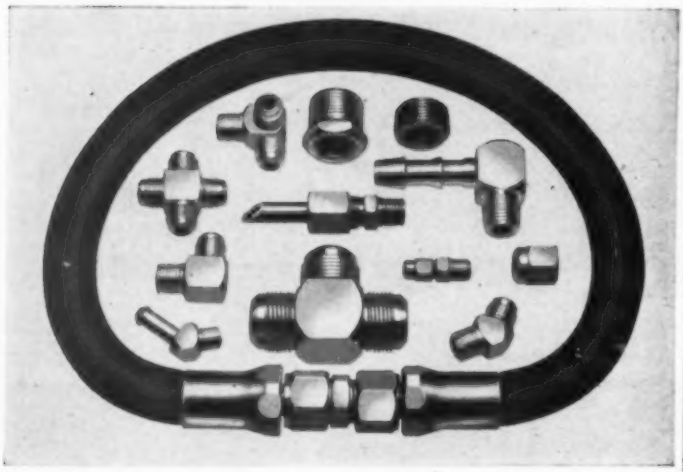
2100 Hyde Park Blvd., Los Angeles 47, Calif.

919 N. Michigan Ave., Chicago, Ill.

WHEN YOU CHANGE TO

J.I.C. Standards

LET L & L SERVE YOUR HYDRAULIC PIPING NEEDS



- **STEEL TUBE COUPLINGS**
  for ⅛th to 2 inch O.D. tubing
  2 PIECE TITE-SEAL FOR ECONOMY
  3 PIECE LOCK-JOINT-SLEEVE TYPE
- **HOSE ASSEMBLIES**
  with pressed-on couplings for single and double wire braid hose
- **PIPE FITTINGS**
  Straights, Ells and Tees with "Dry-seal" pipe threads (N.P.T.F.)
- **PRE-FABRICATED TUBES**
  Let us estimate your preformed tube assembly needs.

• Your installation problems are solicited. Write for catalog and technical data. We also have technical and sales representatives in your area for your convenience. All standard items are shipped from stock the same day your order is received. Excellent service on "Specials".
A few select territories are still available to progressive distributors of Hydraulic equipment—Inquiries invited.

Hydraulic Accessories

L & L Manufacturing Co.

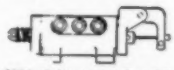
8088 EAST NINE MILE RD. VAN DYKE, MICH.

MODERNAIR C V SERIES

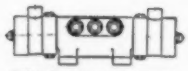
the "Versatile Valve"

FOR AIR, WATER & LOW PRESSURE HYDRAULIC SERVICE

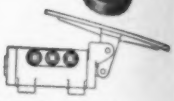
Twenty different left and attachments are available for use with each of 14 Modernair basic valve models — nine of which are illustrated below. In all, nearly 280 distinct valve combinations may be produced using the basic body casting in either ⅜ or ¾-in. pipe size.



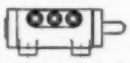
1711—Cable operated model, cable connection attachment only. External compression spring return. (Opposite 02).



0606—Electric operated model, solenoid controlled secondary valve attachment. Solenoid electric controlled return.



1401—Foot operated model, treadle attachment; manual setting.

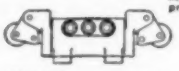


1502—Cam operated model, cam stem attachment; internal compression spring return.

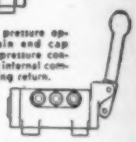
1606—Hand operated model, palm attachment; single coil electric controlled return.

0502—Pilot pressure operated, plain end cap tapped for pressure connection only; internal compression spring return.

1302—Foot operated model, pedal attachment; internal compression spring return.



0808—Cam operated model, roller cam attachment; roller cam return.



1001—Hand operated model, lever attachment; manual setting.

FOR DESCRIPTIVE BULLETIN — WRITE:

Modernair TRADEMARK CORPORATION

4222 HOLLIS STREET · OAKLAND 8, CALIF.

"M-B" AUTOMATIC Air Line FILTER, REGULATOR and LUBRICATOR ASSEMBLY

"Sentinel of the Airline"

Also Pneumatic Grinders

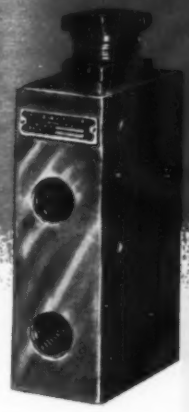
Remember, Built-in quality remains long after first-cost disappears

FILTER element removes solids .00039 and larger. TRANSPARENT BOWL provides visibility. REGULATOR is capable of passing large volume with an unrestricted flow and minimum amount of pressure drop. Self-bleeding, compact, simple. Machined from bar aluminum. LUBRICATOR delivers desired volume of oil. Adjustable Venturi Valve permits efficient operation on broad range of volume and pressure. Bowl can be refilled without shutting off air supply. Any of these 3 devices can be used as separate units or in any combination.

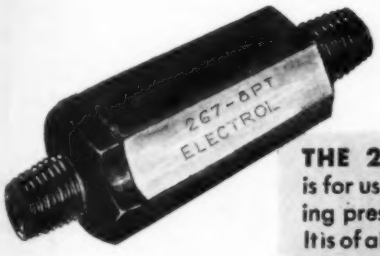
M-B PRODUCTS
46 Victor Avenue
DETROIT 3, MICHIGAN

Specify Electrol RELIEF and CHECK VALVES

Where Applications Call for QUIET . . . PRECISE PRESSURE and CONTROL



THE 523 RELIEF VALVE is compact in design, light in weight, neat in appearance, and can be easily and quickly installed.



THE 267 CHECK VALVE is for use in air or oil at operating pressures up to 1,500 p.s.i. It is of aluminum alloy construction, and is designed especially for small space installations.

THE 463 CHECK VALVE is for use in air, oil or water at operating pressures up to 5,000 p.s.i. It is of brass and bronze construction, and is highly adaptable to heavy-duty service.

No matter whether they're employed to meet the exacting requirements of a maker of X-Ray equipment, or measure-up to the heavy-duty demands of a machine tool builder — Electrol Relief and Check Valves provide precise pressure and flow control . . . *and work quietly together.*

The Electrol Relief Valve is of poppet-type construction, which assures fast, accurate, squeal-free pressure control. It has a wide range of adjustment, and can be set to the desired position, easily and quickly, by turning a fine, screw-thread adjusting cap.

Electrol Check Valves are designed to eliminate any possibility of excessive pressure drop, and are equipped with a patented O-ring check seat, which provides a quick acting, positive check of reverse flow from 0 up to the maximum operating pressure.

Let us supply you with further details, or—if you wish — have one of our engineers call at your convenience.

Better Designed Products Use Electrol Hydraulics

Electrol

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KINGSTON, NEW YORK

CYLINDERS • SELECTOR VALVES • FOLLOW-UP VALVES
CHECK VALVES • RELIEF VALVES • HAND PUMPS
POWERPAKS • LANDING GEAR OLEOS • SOLENOID
VALVES • ON-OFF VALVES • SERVO CYLINDERS • TRANSFER
VALVES • CUT-OUT VALVES • SPEED CONTROL VALVES

FOR BETTER HYDRAULIC DEVICES

Roylyn COUPLINGS

IMPORTANT FEATURES

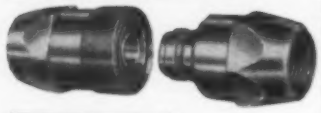
- LIGHT WEIGHT
- QUICK CONNECTING
- POSITIVE LOCKING
- HIGH PRESSURE SEAL
- VIBRATION PROOF
- WIDE TEMPERATURE RANGE
- SIZES FROM ⅛ INCH TO 6 INCH

* FOR MANY VARIED INDUSTRIAL USES:

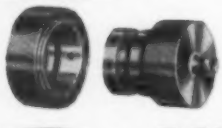
- Railroad Diesel fuel lines
- Marine fuel loading lines
- Tank and Line Pressure Tight Caps
- Processing and Chemical Industries
- Petroleum loading valves and connections
- Liquid transfer and closed hydraulic systems

OPEN COUPLINGS

SELF-SEALING COUPLINGS



CAPS & PLUGS



Features like these mean CONNECT WITH ROYLYN!

★ *SIZE RANGE* . . . ⅛ inch to 2½ inches. Up to 6 inches in some styles.

★ *PRESSURE RANGE* . . . 6600 to 650 P.S.I.

★ *MATERIALS* . . . Aluminum alloy, brass, carbon steel, alloy steel and stainless steel.

★ *OPERATION* . . . A simple "twist of the wrist"—NO TOOLS REQUIRED!

★ *POSITIVE LOCK* . . . Locks with a "snap" and positively will not uncouple with vibration, pressure or rotation of the connected hose.

★ *SAFETY* . . . Laboratory tests for extremes of heat, cold, vibration and years of hard service have proven its rugged reliability.

★ *VERSATILITY* . . . Open nipple can be used with self-sealing coupling to provide shut-off on one side only. Also open coupling can be used with self-sealing nipple to provide check valve action.

There is a Roylyn Coupling available for practically any type of flexible connection for air, water, hydraulic and chemical applications. Write today for free illustrated catalog and nearest dealer. Inquiries regarding available dealerships are invited.

Roylyn INCORPORATED

ROYLYN, Incorporated

714 W. WILSON AVE., GLENDALE 3, CALIF.

Roylyn makes Good Connections for You!

PEMACO HYDRAULIC AND AIR CYLINDERS

Designed to J.I.C. Hydraulic Standards

PEMACO HYDRAULIC CYLINDER

The reputation enjoyed by PEMACO for building first quality hydraulic and air cylinders was not acquired by chance. Sound engineering, modern design, the finest materials combined with years of experienced craftsmanship, has resulted in recognized acclaim throughout industry

Check these 11 points of superiority of the PEMACO HYDRAULIC CYLINDER:

- **"Heavy duty" hi-tensile cast iron castings (steel castings optional).**
- **Ample bronze bearing—oriented behind packing to reduce surge pressure.**
- **New type, low friction ram seal.**
- **"Seal guard" ram scraper gives positive packing protection.**
- **50 Rockwell — hardened and grounded steel ram — score resistant.**
- **Automotive type piston rings.**
- **"O" ring seals.**
- **Internal snap type keeper ring.**
- **Piston and ram positively secured by patented lock nut.**
- **Precision honed steel tubing.**
- **Designed to J.I.C. Hydraulic Standards.**

Write for complete information and engineering data.

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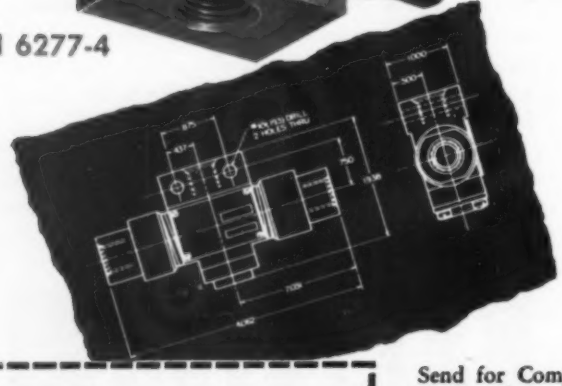


3,000 psi AN Approved

KENYON SHUTTLE VALVE

THE KENYON SHUTTLE VALVE WAS SPECIFICALLY DESIGNED TO . . .

- *Eliminate* failure due to "O" ring swelling . . .
- *Rapidly* shuttle against a *blocked line* . . .
- Produce *zero* leakage during shuttling cycle . . .
- Permit side loads on the shuttle to *transmit* directly to the body, leaving the pistons free to *align* themselves . . .

Years of experience in hydraulics has again resulted in Kenyon producing a unit which exceeds specifications . . .

KENYON

KENYON

INSTRUMENT CO., INC.

HUNTINGTON STATION, L. I., N. Y.

KENYON INSTRUMENT CO., INC.
1439 New York Ave.,
Huntington Station, L. I., N. Y.

GENTLEMEN:

Please send me the folder containing complete engineering data on the AN approved 3,000 psi Shuttle Valve.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

Send for Complete Engineering Data Folder . . .

OTHER DEVICES MANUFACTURED BY KENYON . . .

HYDRAULIC . . . Check, Relief, Restrictor, Multiple Selector, Thermal Expansion Valves, Balanced Relief Valves, Line Filters. PNEUMATIC . . . Pressure Regulators, Solenoid Actuated Valves. FUEL AND OIL VENT SYSTEM . . . Vacuum Check, Vent Check, Check-Relief Valves. CONTROLS . . . Flexible Shafts, Gear Boxes, Tab Actuators, Torque Tube Drives. PRESSURE GAGES . . . Accumulator Charging, Differential Pressure and Hydraulic. ULTRA-SENSITIVE TEMPERATURE DETECTORS for all temperature ranges.

Distributors Approve Bonded Stock Program

The Aviation Distributors and Manufacturers Association, at their mid-year meeting at the La Salle Hotel, Chicago, June 12-14, approved the Bonded Stock Program of the U.S.A.F. This program, set up by an AMC directive dated May 10, provides that certain items of AN hardware, parts and equipment, inspected by the government at the source may be stocked by distributors and users in sealed containers.

Essentially, the Bonded Stock Program is aimed at reducing at least one inspection, thereby reducing inspection and handling costs and accelerating deliveries to government contract users. The directive does not change established original inspection procedures or affect qualified supplier's listings nor does it scrap any stocks now in the hands of distributors or users. The directive does set up requirements for both the manufacturers' and distributors' plants.

The Bonded Stock Program in practice will mean that any sealed package, bearing the original label and inspector's seal can be accepted by the distributor and the user without additional inspection.

Products covered by the directive include bolts, screws, pins and nuts initially with an understanding that fittings and other items, including "O" rings will be also included later.

A committee, appointed at the meeting, is now at work in an effort to determine sizes of containers for various items.

The Bonded Stock Program was presented to the meeting by A. E. R. Peterka and discussed in detail by Maj. Gene Shoemaker and O. E. Stutsman of AMC and Captain Warren C. Dean, W. Nagle and Gerald R. DuKet of the Chicago AF Procurement Field Office.

Arrowhead Rubber Moves Into New Plant

Completion of construction on the new, modern plant of the Arrowhead Rubber Company, division of National Motor Bearing Co., Inc., has been revealed by L. A. Johnson, National Motor Bearing president. Site of the plant is approximately twenty minutes to the southwest of Los Angeles at Downey, California. The new plant embodies the latest developments in modern construction and factory design. The new factory, necessitated by Arrowhead's rapid growth and diversification since the war, provides greatly increased floor space and additional production facilities to accommodate the company's increased production schedules. Provisions have also been made for future expansion, according to H. K. Pohlman, Arrowhead president.

The plant layout consists of three separate buildings, so located that the maximum in efficiency, cleanliness and convenience is achieved. The compounding and milling departments, and the raw materials warehouse are located in one building separate from the rest of the plant, thus keeping the main factory building and general office building free of dust and carbon black.

Compounds and raw materials are withdrawn from the warehouse and compounding departments and trucked on a runway directly to the stock preparation and extrusion departments in the main factory.

Hydraulics Conference

The tentative program for the sixth annual National Conference on Industrial Hydraulics, October 18 and 19 at the Sherman Hotel, Chicago, has been announced by Frank W. Edwards, conference secretary.

No costly mechanisms needed!

Lindberg Double Acting Air Cylinders are proving their adaptability and worth in a wide variety of industrial uses. These simple, dependable, efficient and versatile cylinders are effecting considerable savings throughout industry by the reduction or complete elimination of costly mechanisms involving cams, gear drives and complicated set-ups.

Don't forget—with slight modifications, any size or model of Lindberg Air Cylinder may be used for low pressure hydraulic applications.

WRITE FOR NEW BULLETIN 731—this 16 page catalog just off the press gives details of all standard Lindberg Air Cylinder models and sizes with complete tables on bores, pressures, weights, mountings and conversion to low pressure hydraulics.

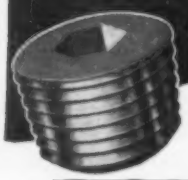
Remember—BULLETIN 731 for COMPLETE DETAILS ON AIR CYLINDERS

LINDBERG
AIR & HYDRAULIC CYLINDERS

Lindberg Engineering Company
2441 West Hubbard Street Chicago 12, Illinois

Specify Lindberg
when you need HYDRAULIC CYLINDERS
OIL HYDRAULIC PUMPING UNITS
MILL TYPE CYLINDERS • CENTRIFUGAL
BLOWERS • AIR VALVES

NEEDS NO SEALING COMPOUND



UNBRAKO

DRYSEAL
THREAD
PRESSURE PLUG

. . . seals pressure-tight without the use of sealing compounds. Features the "Dryseal" Pipe Thread originally developed for use with SO_2, ammonia, and other refrigerants. Offers a valuable solution to leakage problems in high pressure equipment of all kinds.

Unique design of the "Dryseal" Thread provides actual crushing and sealing at both major and minor diameters, effectively preventing spiral leakage, even under extreme pressures.

Incorporates all the important features of the regular UNBRAKO Pressure Plug, including fully formed threads, uniform taper and perfect roundness.

A full range of sizes from 1/16" to 1¼", National Pipe Thread Fuel, is available. Full details are given in Bulletin 675.

OVER 47 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.

JENKINTOWN 2, PENNSYLVANIA

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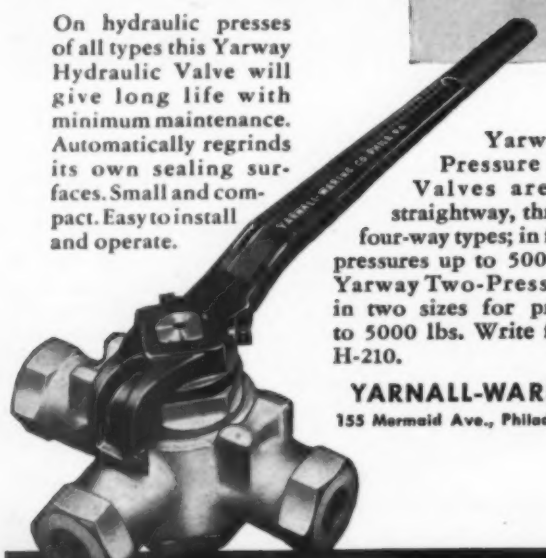
The Higher the Pressure ...the Tighter the Valve

On hydraulic presses of all types this Yarway Hydraulic Valve will give long life with minimum maintenance. Automatically regrinds its own sealing surfaces. Small and compact. Easy to install and operate.

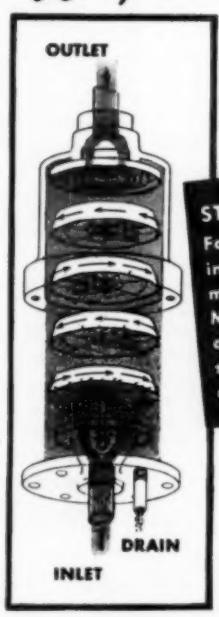


Yarway Single-Pressure Hydraulic Valves are made in straightway, three-way and four-way types; in five sizes for pressures up to 5000 lbs. Also Yarway Two-Pressure Valves in two sizes for pressures up to 5000 lbs. Write for Bulletin H-210.

YARNALL-WARING CO.
155 Mermaid Ave., Philadelphia 18, Pa.

YARWAY
Improved Type
HYDRAULIC VALVE

Why does an ARIDIFIER



REMOVE 92% OIL, WATER AND DIRT FROM GAS AND AIR LINES?

STUDY EXPLODED VIEW FOR ANSWER

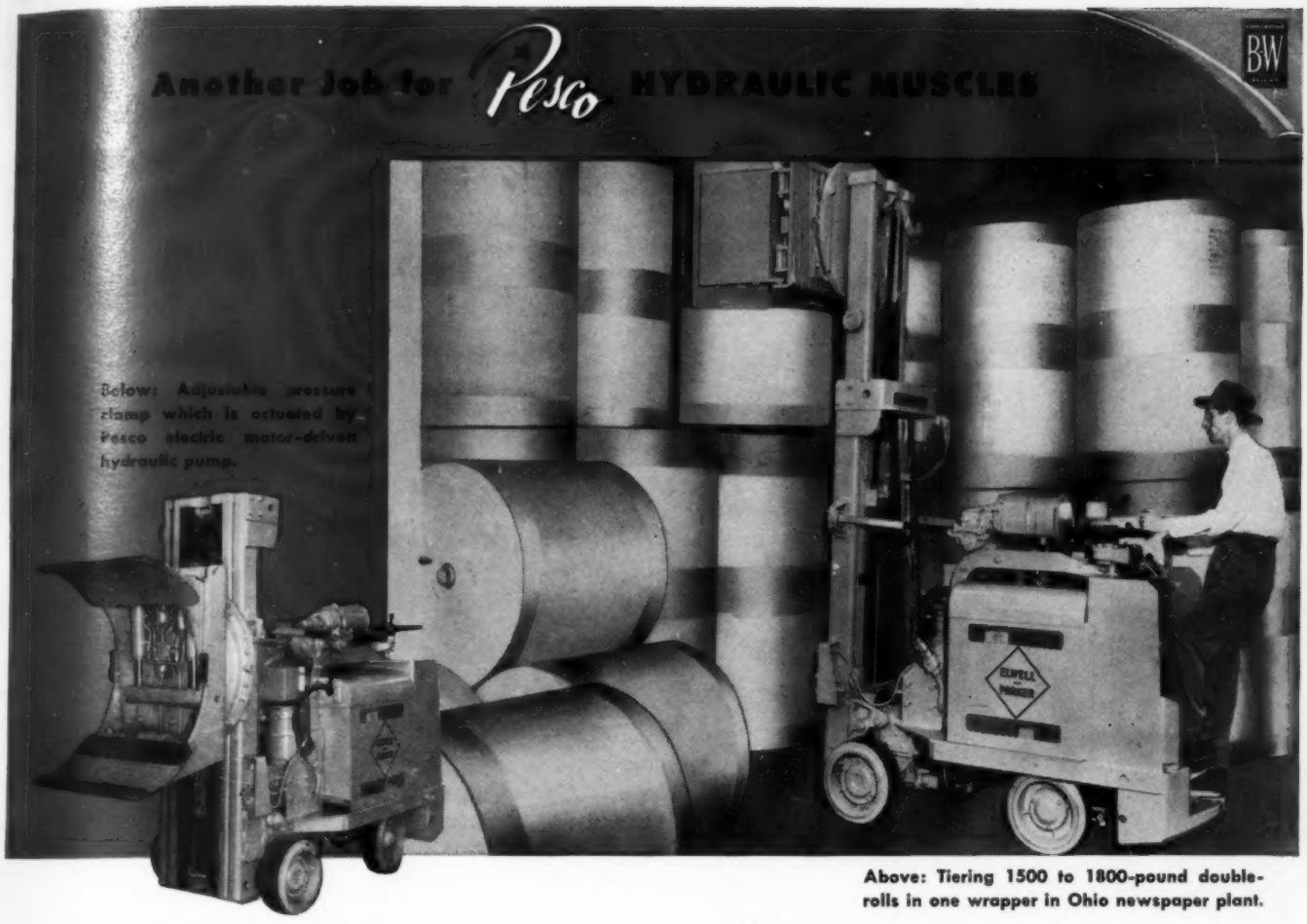
Four multi blade rotors revolve at high speed in opposite directions under impact of air movement through non-aligned rotor spaces. Moisture, dirt and other foreign matter which collect on rotor blades are thrown out of air stream by centrifugal force to side of housing, and pass into drain.

For paint and lacquer spraying, ceramic, sand blasting, air cleaning, etc. Easily replaces less efficient baffle type devices. Tell us details of your problem when you write for a catalog.

CAPACITY RANGE: AS LOW AS 7 CFM TO 17,000 CFM.

Made By The Manufacturers of Logan Lathes and Shapers.

Logan ENGINEERING CO.
4920 W. LAWRENCE AVE., CHICAGO 30, ILL.


Another Job for Pesco HYDRAULIC MUSCLES
BW
Below: Adjustable pressure clamp which is actuated by Pesco electric motor-driven hydraulic pump.

Above: Tiering 1500 to 1800-pound double-rolls in one wrapper in Ohio newspaper plant.

HEAVY rolls of paper handled easier, faster

. . . with new Elwell-Parker, Pesco-equipped Clamp Truck

This Pesco hydraulic motor has displacement of 1.92 cu. in. and develops 4.4 hp. at 1000 p.s.i. at 1200 r.p.m.

Capacity of this Pesco electric motor-driven pump is 1.6 g.p.m. at 1650 p.s.i. at 27 volts d-c.

Savings up to 75 per cent in time—savings in storage height and the ability to "nest" paper rolls weighing up to 3500 pounds are some of the advantages of this new Clamp Truck.

Two Pesco units help to make these savings possible. A Pesco electric motor-driven pump moves the clamp that grasps the paper roll and holds it firmly, but without damage to the paper, while stacking. And a Pesco hydraulic motor provides the power that rotates the clamp mechanism so that the rolls may be stacked on end or laid on their sides.

The preciseness, ease and speed with which Pesco hydraulic muscles handle heavy, awkward loads is only one of many important reasons why more and more industrial equipment manufacturers are turning to Pesco for answers to their hydraulic power problems.

For the complete story of how the sales power of Pesco Pressurized Power can help you, write today.

engineering Pesco production

PRODUCTS DIVISION

BORG-WARNER CORPORATION

24700 NORTH MILES ROAD BEDFORD, OHIO

What is so right about this picture?

IS IT THAT Dad's finally retired . . . the old alarm clock gagged for good?

Is it because now Mom won't have to watch him leave for the office any more, looking just a little bit tired?

Or is it because now Dad and Mom will be starting an especially happy time of life *together?*

We think it's all these things—all the things that are only made possible by financial security.

Nearly everyone seeks financial security, but *far too few* find it. That's because financial security seldom is achieved without a *sound, carefully executed* savings plan!

U. S. Savings Bonds offer you two absolutely safe, automatic plans for saving: The *Payroll Savings Plan* where you work or the *Bond-A-Month Plan* where you bank.

By signing up for one or the other of these plans, U. S. Savings Bonds are purchased for you out of your savings or income . . . automatically. You *can't* forget to save . . . your saving is done for you! And remember, U. S. Savings Bonds pay you *4 dollars for every 3* invested, in ten years.

Start planning your own retirement today!

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